Electrical Contracting

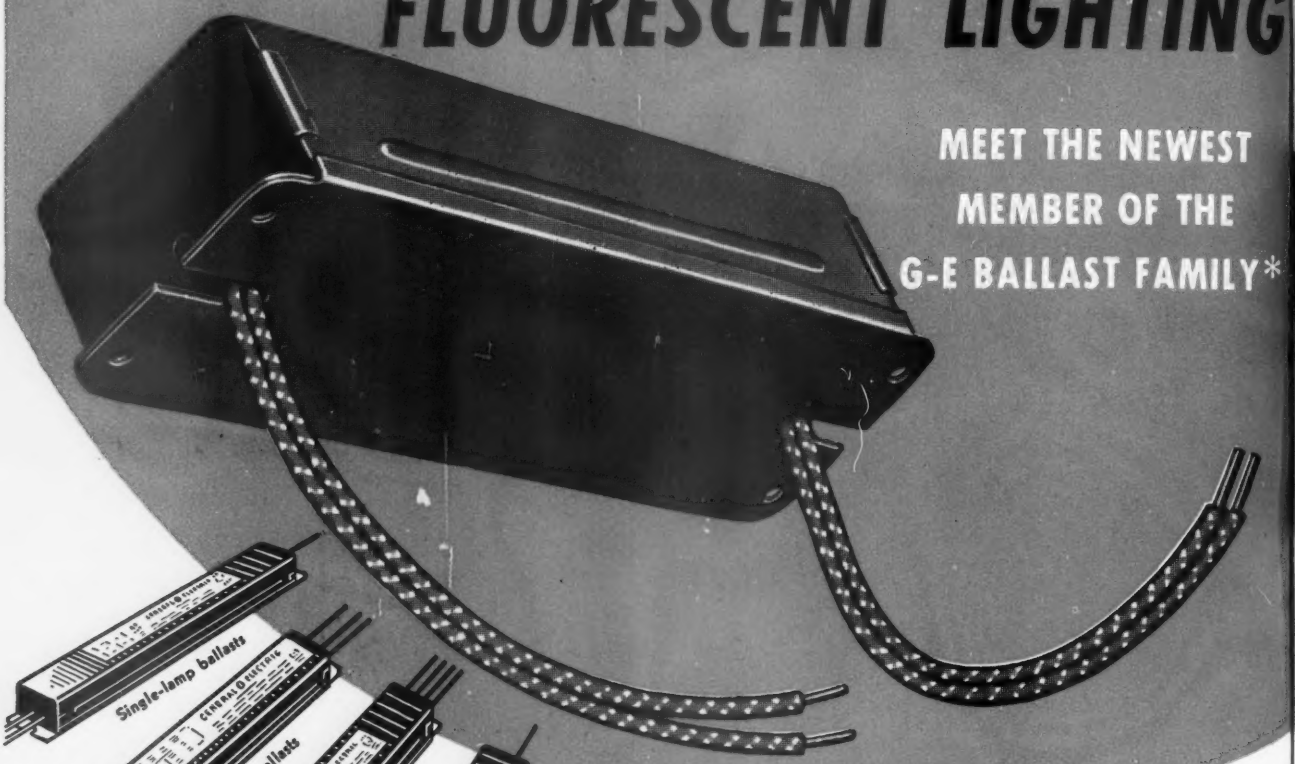
JULY
1944

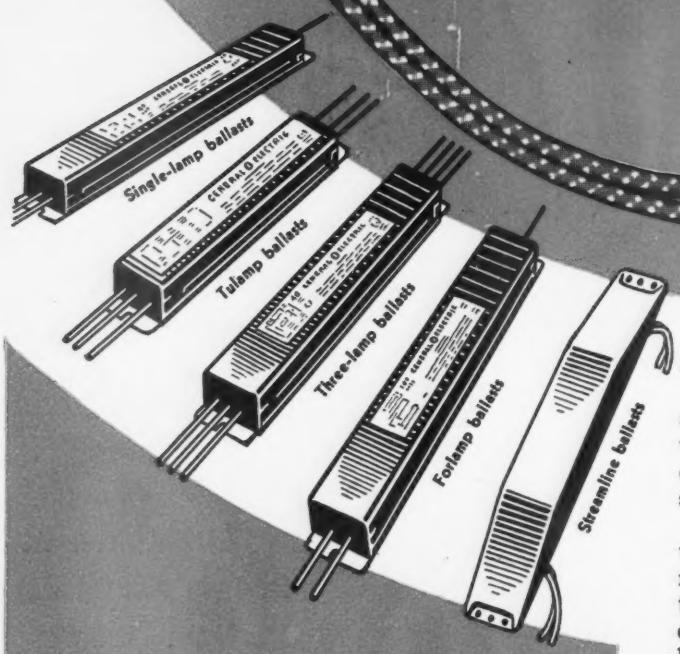
Magazine of
ELECTRICAL CONSTRUCTION AND MAINTENANCE

IN THIS ISSUE... Hi-voltage for light distribution... What's ahead in the '45 Code ...How to organize for small motor repair... Contractors are good pay... What to do about electrical apparatus fires... How the adequate wiring campaign is doing... More about selecting controls for squirrel-cage motors... How to shoot trouble on electronic apparatus... And a host of practical ideas for the shop and the job.

for operation of INSTANT-STARTING FLUORESCENT LIGHTING

MEET THE NEWEST MEMBER OF THE G-E BALLAST FAMILY*





THIS high-voltage, Tulamp ballast has been de signed for the operation of new 40-watt instant starting fluorescent lamps. At starting, it applies 45 volts to the lamp, striking an arc between the lamp cathodes, and thus eliminating the need for separat starter equipment.

At nominal circuit voltage, the ballast delivers rate watts to the lamps. Uniform light output is closely maintained even when the circuit voltage varies within the recommended operating range. Power losses, how ever, are greater than in the conventional prehea ballast circuit.

Like all other G-E Tulamp ballasts, this design pro vides high power factor and gives excellent correction of cyclic light flicker. Special filters for suppression o radio interference are incorporated.

The new high-voltage ballast is currently available in Tulamp 40-watt ratings for use on 118-volt circuits It is housed in a standard-sized, universal case tha allows the leads to be brought out the end or bottom permitting great flexibility of installation and complete utilization of present fixture designs.

This ballast development, as well as the recent in troduction of G-E MAZDA F lamps for instant-starting circuits, is just one more example of the never-ending lighting progress led by General Electric research.

For further information, including diagrams o instant-starting circuits, ask our nearest office fo Supplement No. 2 to publication GEA-3293E. O write to General Electric Co., Schenectady 5, N. Y.

* THIS new, high-voltage ballast, an addition to our diversified line, will find its most advantageous use only where instant starting is a definite benefit.
Pictured above are representative types of G-E ballasts for the conventional preheat system. For most installations, such ballasts are still the most economical and efficient method of operating fluorescent lamps. Steady improvement in G-E MAZDA F lamps, and the use of the new G-E Watch Dog starter to prevent flicker, combine to assure ever greater acceptance of the preheat system of lamp operation.

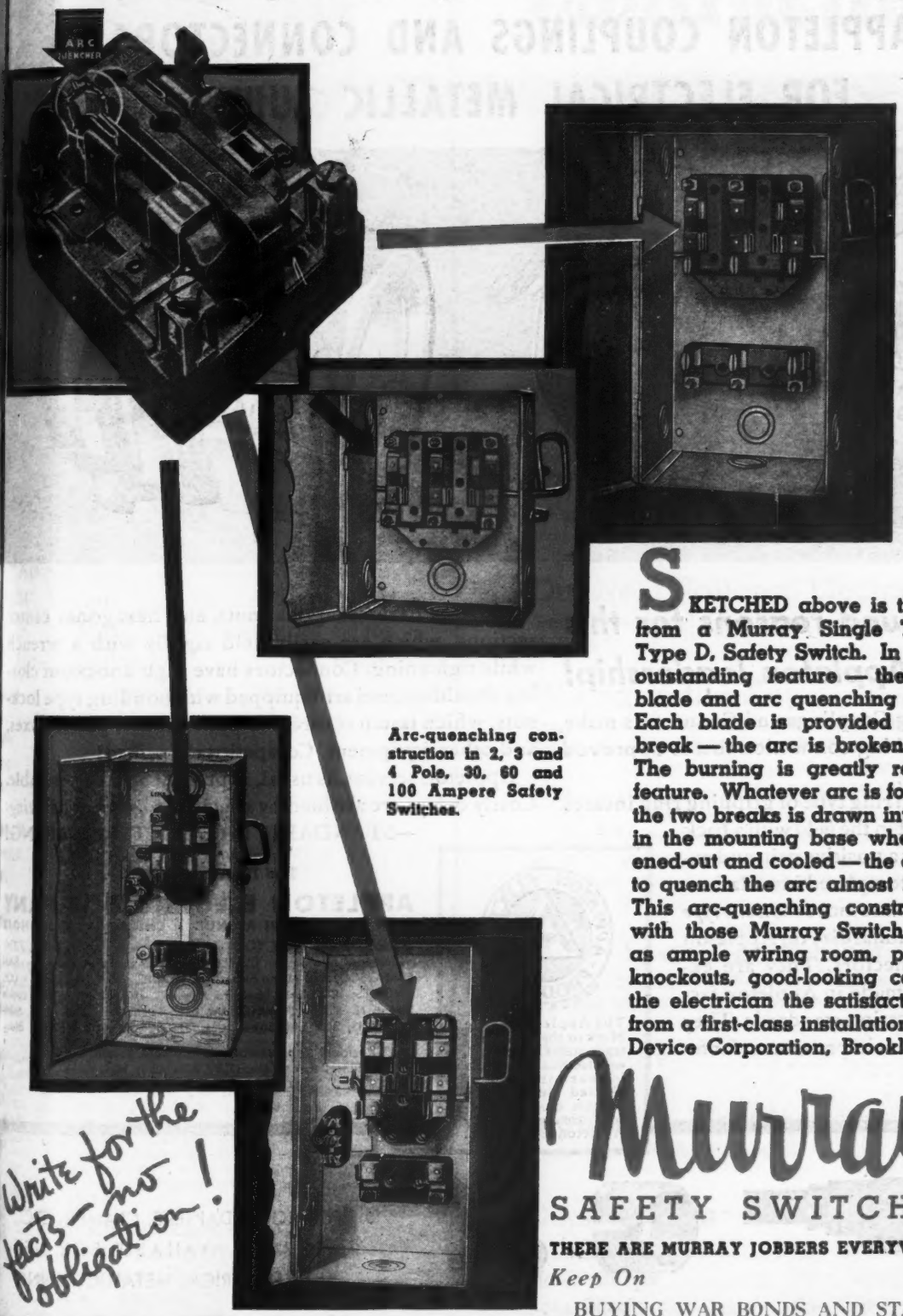
BALLASTS FOR FLUORESCENT LIGHTING

GENERAL ELECTRIC

409-23-48

"A FIRST CLASS INSTALLATION", *say electricians*

(*and they also say,* "SO EASY TO PUT IN")



Arc-quenching construction in 2, 3 and 4 Pole, 30, 60 and 100 Ampere Safety Switches.

SKETCHED above is the switch block from a Murray Single Throw, Fusible, Type D, Safety Switch. In the circle is the outstanding feature — the double break blade and arc quenching chamber.

Each blade is provided with a double break — the arc is broken into two parts. The burning is greatly reduced by this feature. Whatever arc is formed at each of the two breaks is drawn into a narrow slot in the mounting base where it is lengthened-out and cooled — the effects co-acting to quench the arc almost instantly.

This arc-quenching construction coupled with those Murray Switch characteristics as ample wiring room, properly placed knockouts, good-looking cabinets, assure the electrician the satisfaction that comes from a first-class installation. Metropolitan Device Corporation, Brooklyn, New York.

Write for the facts — no obligation!

Murray

SAFETY SWITCHES

THERE ARE MURRAY JOBBERS EVERYWHERE

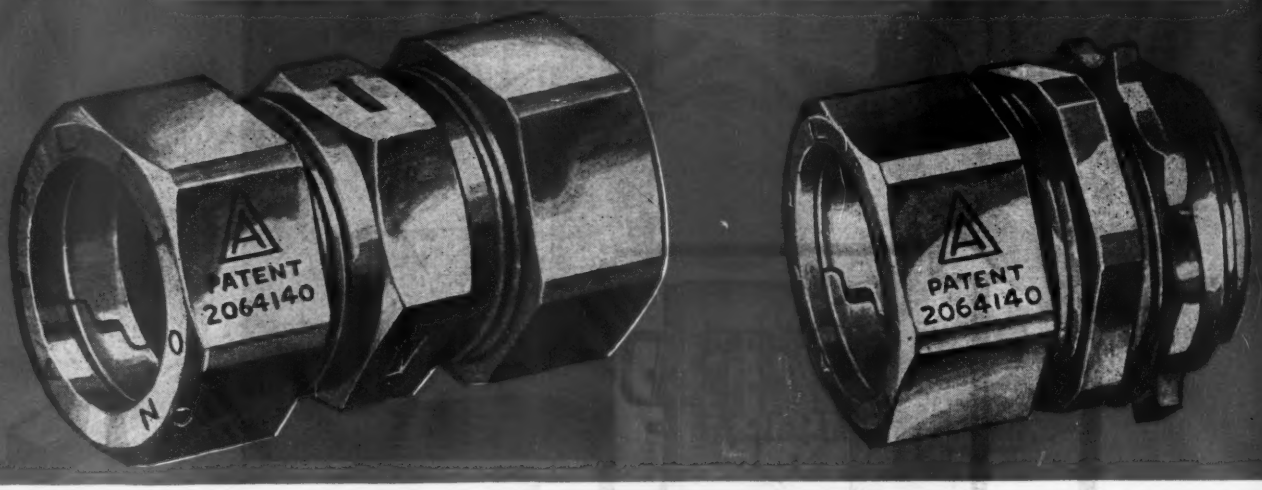
Keep On

BUYING WAR BONDS AND STAMPS

ELECTRICAL CONTRACTING. Published monthly, price 25 cents a copy. Vol. 43, No. 7. Allow at least ten days for change of address. RETURN POSTAGE GUARANTEED. Publication Office, 99-129 N. Broadway, Albany, N. Y. All communications about subscriptions should be addressed to the Director of Circulation, Electrical Contracting, 330 West 42nd St., New York 18, N. Y. Subscription Rates— U. S. A. and Latin American Republics, $2.00 a year, $3.00 for two years, $4.00 for three years. Canada $2.50 a year, $4.00 for two years, $5.00 for three years. Great Britain and British Possessions, 18 shillings for one year, 36 shillings for three years. All other countries $3.00 a year, $6.00 for three years. Entered as second-class matter August 29, 1936, at Post Office, Albany, N. Y., under the Act of March 3, 1879. Printed in U. S. Cable address: "McGraw-Hill, New York." Member A. B. P. Member A. B. C.

More Now in Service Than All Others Combined!

APPLETON COUPLINGS AND CONNECTORS FOR ELECTRICAL METALLIC TUBING



There are sound reasons for this outstanding Appleton leadership!

Appleton Gland Ring Couplings and Connectors make a rigid, permanent tubing connection that is ***approved watertight!***

The concave, piston ring type of gripping ring insures an easy fit on tubing cut in the field with a hack saw, thereby assuring a positive grip and extreme rigidity in the completed installation.

It is not necessary to use more than *one type* of fitting when you standardize on Appleton Couplings and Connectors. They are expertly designed, and made in Appleton factories to high specification standards. They embody every important improvement for fittings of their type.

All sizes have hexagonal nuts, and hexagonal center sections, which are easily held rigidly with a wrench while tightening. Connectors have high knockout closing shoulders, and are equipped with bonding type locknuts, which fasten securely to outlet boxes, panel boxes, and other equipment. Competitively priced!

Appleton service, as usual, is prompt and dependable. Costly delays are avoided by specifying *Appleton Fittings*

—STANDARD FOR BETTER WIRING

APPLETON ELECTRIC PRODUCTS REG. U.S. PAT. OFF.

The Appleton Trade Mark or the registered trade name, "Unilets", on electrical materials is your assurance of skilled design and highest quality. "Unilets", are made only by Appleton Electric Co.

Sold Through Wholesalers

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1704 WELLINGTON AVENUE • CHICAGO 13, ILLINOIS

Branch Offices: NEW YORK, 76 Ninth Avenue • DETROIT, 7310 Woodward Avenue • CLEVELAND, 1836 Euclid Avenue • SAN FRANCISCO, 655 Minna Street • ST LOUIS, 420 Frisco Bldg. • LOS ANGELES, 100 North Santa Fe Avenue • ATLANTA, 175 Luckie Street, N. W. • BIRMINGHAM, 6 N. Twenty-first Street • MINNEAPOLIS, 305 Fifth Street, S. • PITTSBURGH, 418 Bessemer Bldg.

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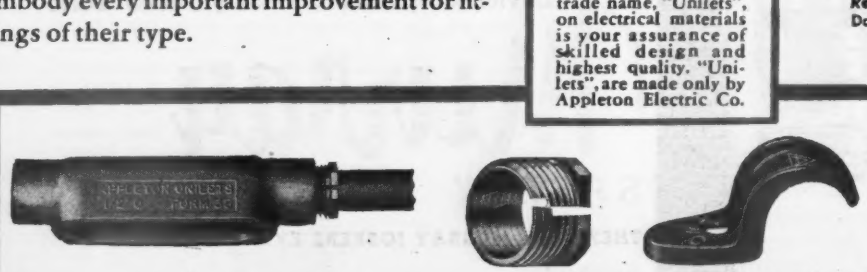
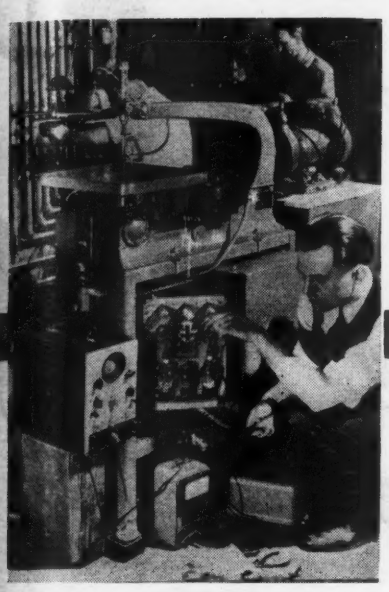


FITTINGS, ADAPTERS, CLAMPS, ETC., ARE ALSO AVAILABLE FOR USE WITH ELECTRICAL METALLIC TUBING

APPLETON

Conduit Fittings • Outlet and Switch Boxes • Explosion-Proof Fittings • Reelitos

Electrical Contracting



OUR COVER—"Testing and trouble shooting on electronic equipment". (A General Electric photo)

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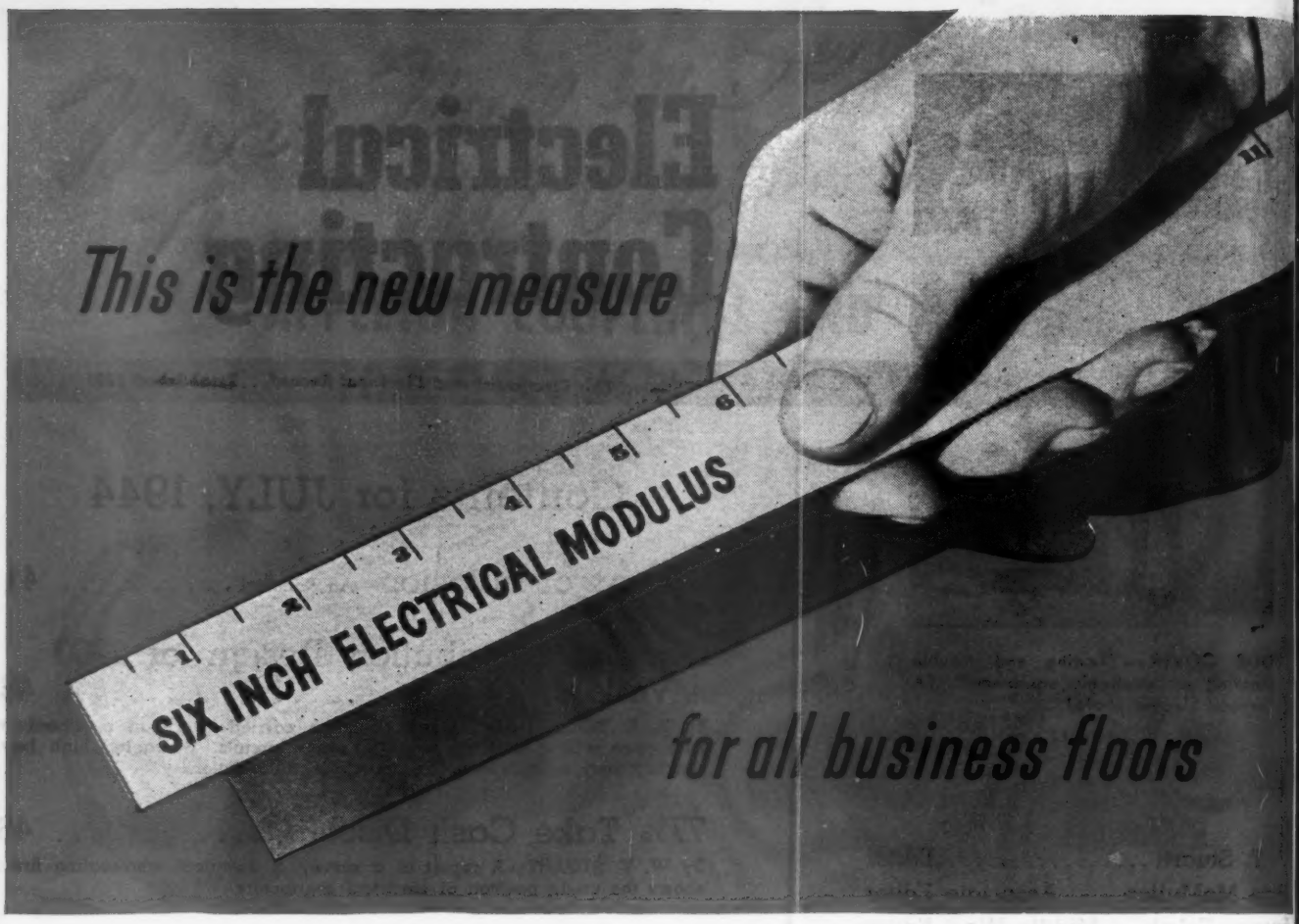
A practical technical and management journal for electrical contractors, industrial electricians, inspection engineers and motor shops, covering engineering, installation, repairing, maintenance and management of the trade of electrical construction and maintenance.

Contents for JULY, 1944

Departments



Q-Floors are a major step in promoting greater use of electricity and increased sale of electrical fittings.

A Q-Floor is constructed of steel raceways so that an outlet can be located at every six inches. This is the new six-inch modulus by which to judge the electrical availability of a floor. Q-Floors enable electrical contractors to promise unlimited service—fast and clean —as changeable as the customer's mind.

The over-all electrical availability of Q-Floors encourages tenants to use more equipment and to call for an electrician every time a piece needs moving. Moreover, owners are willing to relocate outlets as often as desired. Quick change is a sales point stressed by owners of Q-Floors.

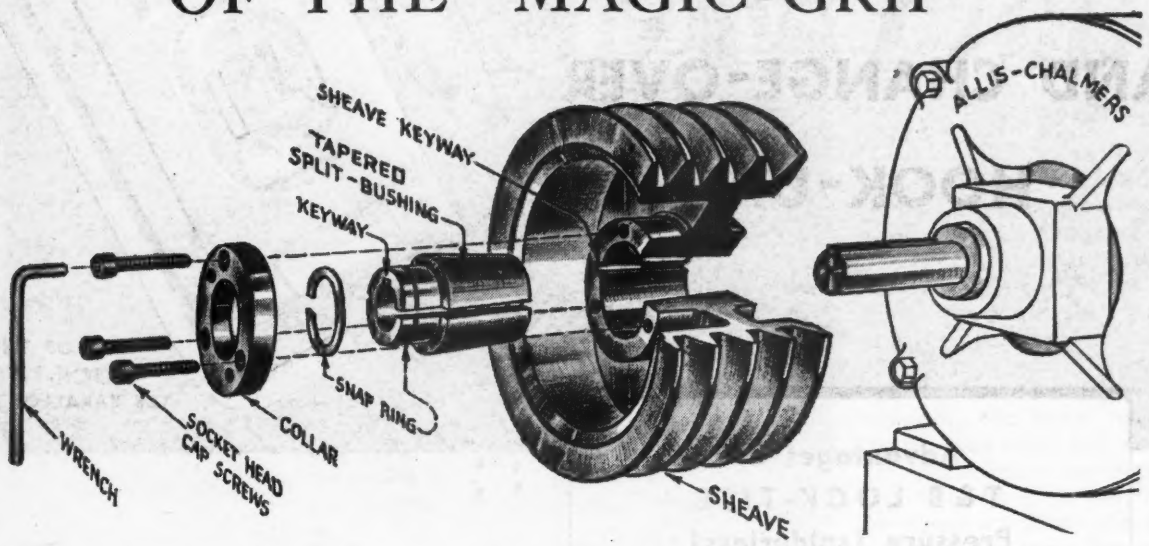
With a Q - Floor — the emphasis is on *electrical service!*

For Q-Floor fittings, get in touch with your local General Electric Merchandise Distributor. He'll be glad to send Q-Floor literature. H. H. Robertson Company, 2400 Farmers Bank Building, Pittsburgh, Pennsylvania.

Q FLOORS
by H. H. Robertson Co.

Here's the Secret

OF THE "MAGIC-GRIP"



Exploded view shows why Allis-Chalmers' new "Magic-Grip" Sheave goes on *as a unit in 3 easy steps.* It's the fastest mounting sheave on the market—at no extra cost.

1 Place sheave on shaft. Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.

2 Slide to desired position. Sliding easily, sheave can be placed *exactly* according to straight-edge . . . giving you true alignment with resulting smooth performance. A minimum of time is required.

3 Tighten three capscrews — and it's ready to go! Entire sheave is locked securely to shaft and *grips like magic!* No set screws to damage shaft. Send for Bulletin B6310. Allis-Chalmers, Milwaukee 1, Wis.

A 1764

Allis-Chalmers Texrope

"MAGIC-GRIP" SHEAVES

FOR YOUR PRESENT AND CHANGE-OVER HOOK-UPS

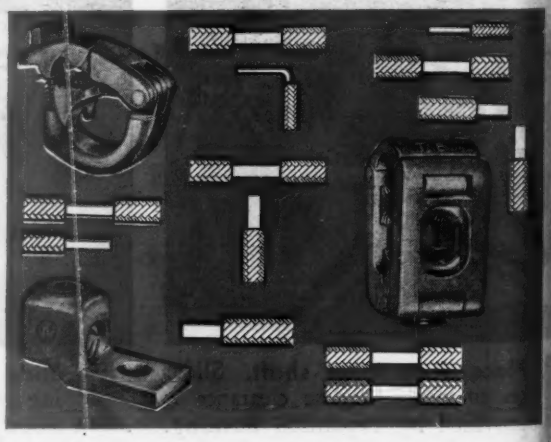
Advantages of
T&B LOCK-TITE
Pressure (solderless)
Connectors

1. Ease of installation. Key wrench or screw driver. No solder.
2. Economy. You need stock only a few Lock-Tite Connectors because they lug or tap any kind of cable, in various combinations.
3. Each Lock-Tite takes several overlapping cable sizes.
4. Resistance to vibration.
5. High conductivity insured by direct pressure contact.
6. Resistance to heat. Lock-Tite Connectors run cooler than the cable itself.
7. High pull out value.
8. 100% salvage value.
9. Underwriters' Laboratories Approvals.

Phone your T & B Electrical Wholesaler for these versatile

T&B LOCK-TITE PRESSURE CONNECTORS

A small stock is all you need to lug or tap any kind of cable up to #1,000,000 CM.



Write today to Dept. EC-7 for T & B Maintenance and Repair Booklet giving the practical information you want.

T&B

THE THOMAS & BETTS CO.
INCORPORATED
manufacturers of electrical fittings since 1899
ELIZABETH, 1, NEW JERSEY
In Canada: Thomas & Betts Ltd. Montreal

What do You Say, Doc?

THE "DOCTOR"— McGarvey Eddleman of Allis-Chalmers Norwood Works— is taking a temperature reading during the heat-run test. It's just one precaution that helps Allis-Chalmers build consistently great motors.

NO—THAT'S NOT a sick motor. Actually it's a very *healthy* one. But that's something we must know — through generous sample testing — before Allis-Chalmers motors can tackle jobs for you.

Part of the "physical exam" that motor at the left must pass is the heat run test. Bristling with thermometers, the motor runs at full load — and speed and temperature are recorded for every hour.

Five or six hours can tell you a lot about a motor's characteristics —but it takes more like five or six *years* to tell you its *character.*

And it's the test of time in which Allis-Chalmers motors have established that they are *great* motors. That's why you hear so many engineers say: "You can depend on Allis-Chalmers Motors!"

• • •

If you could meet and talk with the men who build Allis-Chalmers motors, you might be surprised to learn how keenly they are aware of the big *personal* stake they have in every motor they build for you.

They know that factory tests to fully pre-determine how well a motor is built *just don't exist;* that there's still no substitute for responsible craftsmanship.

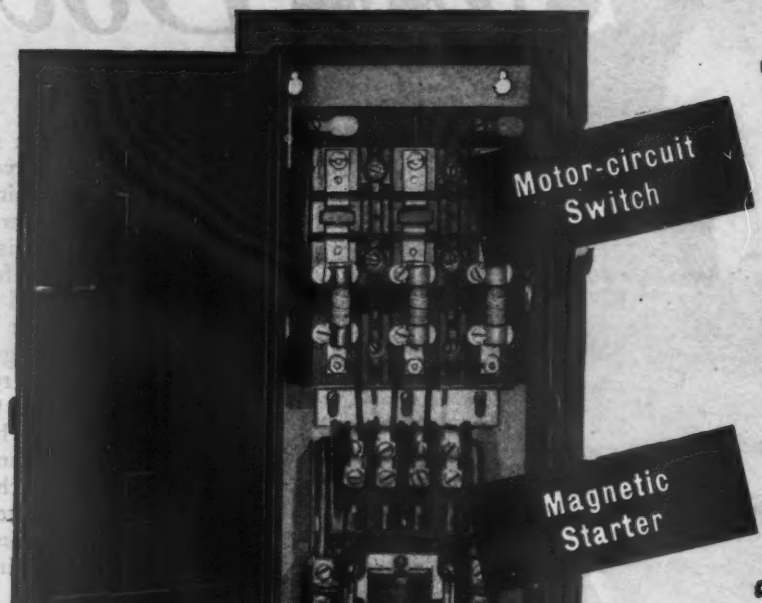
And they know that when they build great motors for you they're making *friends*—and that no company and its workers can have too many of them. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 1726

AC WE WORK FOR VICTORY WE PLAN FOR PEACE

♪ *Tune in the Boston Symphony, Blue Network, Saturday at 8:30 pm, EWT.*

YOU CAN DEPEND ON ALLIS-CHALMERS MOTORS

EVERYTHING YOU NEED to



110 to 600 Volts

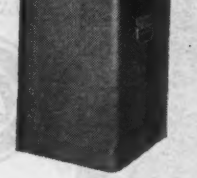
COMBINATION STARTER

Why two devices? ONE can do the job

GENERAL PURPOSE

Type 1 enclosure for indoor applications where atmospheric conditions are normal. Available up to and including NEMA Size 5.

CORROSION-RESISTANT

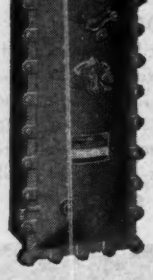


Two forms are available —Type 3 for corrosive atmospheres; Type 8 for hazardous locations. All arcing parts and terminals of Type 8 forms are at least six inches under oil.

DUST-TIGHT

Type 5 enclosure for use in steel mills, cement mills, and other locations where the dust content of the atmosphere is so high as to make a dust-tight case desirable.

FOR HAZARDOUS LOCATIONS



Type 7 case for Class I, Group D, locations is made of cast, high-strength alloy. Designed to withstand internal explosions.

WATER-TIGHT

Type 4 case is suitable for outdoor use, and for damp places indoors; such as dairies, breweries, and piers.

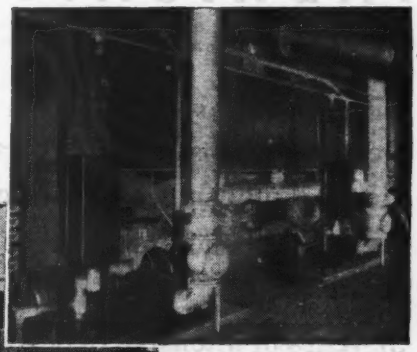
to control and protect your motor in ONE COMPACT CONTROL UNIT

COMPLETE full-voltage control of squirrel-cage motors or the primary control of wound-rotor motors—with extra safety, very low installation cost, good appearance, and other advantages.

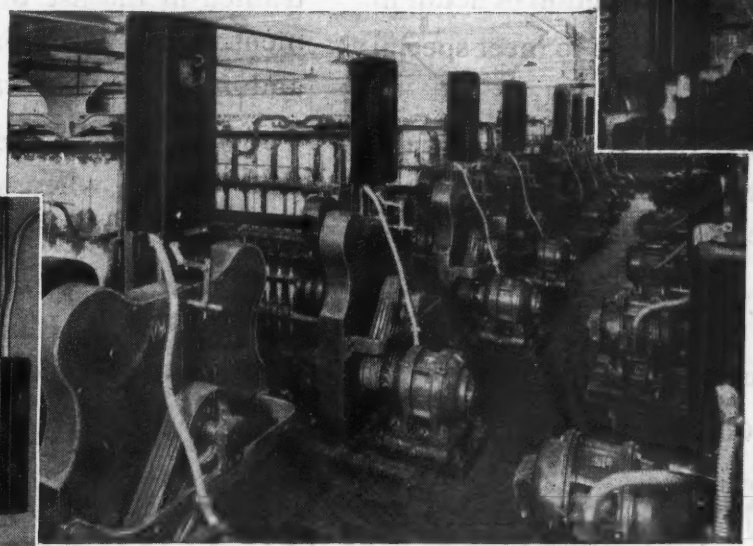
Which Type Do You Need?
If you want short-circuit protection, you can select a starter which has a fusible motor-circuit switch or a breaker to provide such protection. Or, if you do not need short-circuit protection, you can choose a starter which is equipped with a nonfusible motor-circuit switch that serves only as a disconnect. Both types are available in a variety of enclosing cases, as shown on the opposite page.

Co-ordinated for Protection
With G-E combination starters, you're sure that the motor-circuit switch or breaker has the proper rating for the magnetic starter with which it is used. The fuses or breakers provide adequate short-circuit protection to the motor, the starter, and subsequent motor-branch-circuit conductors when connected to a power supply for which they are recommended. The co-ordination of thermal overload relays with the fuses or breakers affords complete motor overcurrent protection under any condition of operation.

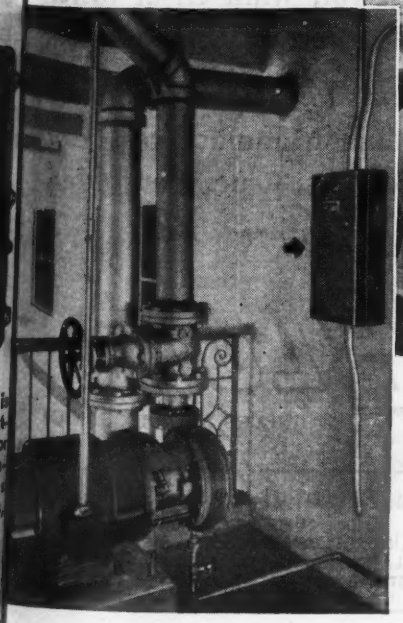
Increased Safety
By placing the motor-circuit switch in the same case with the magnetic starter, the switch can be mechanically interlocked with the cover, so that the cover cannot be opened while there is power on the starter. This is an important advantage because, when a separately mounted switch and starter are used, there is nothing to prevent the operator from opening the case while the starter is "hot."



G-E combination starters can be mounted on or near the machine even in damp locations, such as this pump-room installation.



This combination starter controls a ball-bearing splash-proof motor direct-connected to a centrifugal mash pump in a brewing plant.



Combination starters and shipper-rod switches are used to control the operation of each frame operated by this spinning-frame drive.

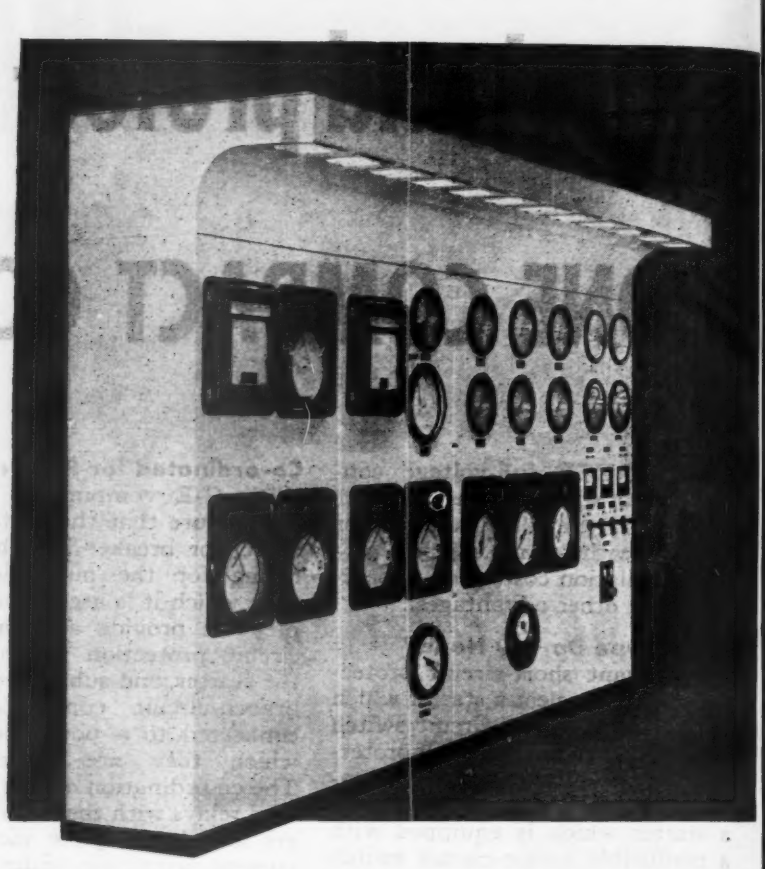
WANT MORE DATA? More complete information on G-E combination starters will be found in Bulletin GEA-3715. Ask our nearest office for a copy or write direct to General Electric Company, Schenectady 5, N. Y.

Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds

GENERAL ELECTRIC

670-130-8920

CONTROL BOARDS



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Kirk & Blum is well known throughout the electrical industry for expert design, accurate workmanship, and perfection of detail in sheet metal equipment made to meet special requirements.

37 years of intensive experience gives us the "know how" to fabricate your Switch Gear Housings, Cubicles, Control Desks, Busway Instrument Panels, etc. *the way you want them.*

Our engineers interpret your blue prints with absolute fidelity. And modern expanded facilities, plus skilled workmen trained in the use of specially built equipment, enable us to produce your work *faster* and *more economically.*

For sheet steel fabrication made the way you want it, when you want it, at lower cost—you can always rely on Kirk & Blum.

Send your blue prints for prompt quotation to The Kirk & Blum Manufacturing Co., 2864 Spring Grove Ave., Cincinnati, Ohio.

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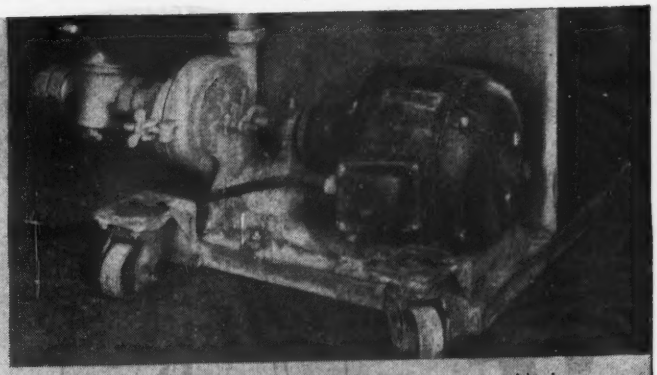
DOUSED DAILY!

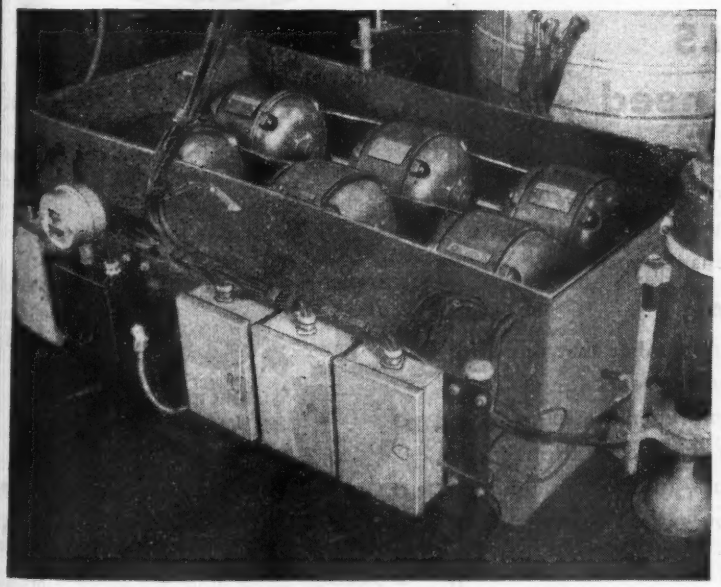


G-E Tri-Clad motor coupled to a centrifugal pump on a portable cleaner in the milk plant of H. P. Hood & Sons, Inc., Charlestown, Mass.

POWERING A DAIRY PUMP, this Tri-Clad splashproof motor gets a dousing every day as the plant is hosed down. After years of service, frame and end shields are virtually uncorroded, insulation is going strong. G-E "protection tests", both in the development of the Tri-Clad design and in our daily production, help us assure you of long-lasting service from Tri-Clads on motor-wracking jobs like this.

"Hot Box" at 100% humidity tests TRI/CLAD motor protection

REG. U.S. PAT. OFF.



Here is one of the many development tests which helped to prove the *extra* stamina engineered into the Tri-Clad design. In the bottom of this moisture box, just below the motor base, two inches of water was maintained at 212 F. The cover kept the humidity within the box at 100 per cent. By operating motors in this atmosphere to the breakdown point, G. E. got the low-down on the coil insulation's moisture resistance. Tri-Clad motors, in both open and splashproof construction, showed up unusually well in this extra-severe test. *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

TRI/CLAD MOTORS

Every week more than 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.

FARADAY SIGNALS
meet every industrial need

Whether your customer's situation calls for bells or buzzers, horns or the 10,000-M blast of the high-power Kodaire, you'll find the right answer in the complete Faraday line. All Faraday equipment is built for long service, easy installation, and minimum maintenance costs.

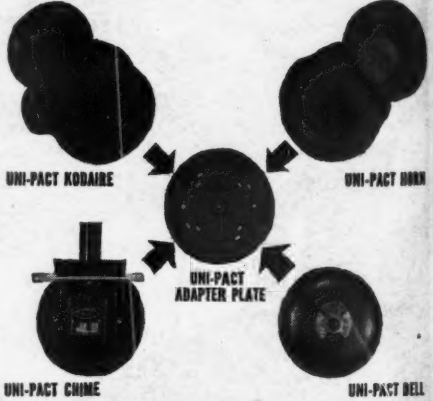
WE BUILD SPECIAL TYPE SIGNALS

Whenever you meet a special signal requirement, remember that our modern plant at Adrian is equipped to handle special orders for designed-to-order signaling devices, as well as the comprehensive standard lines in our catalog. All you need to do is get the specifications, mounting details, and other information—send it to us—and Faraday engineers will go to work on the problem, to help you get the business!

Get This FREE Handbook—The latest Faraday catalog is a veritable handbook of modern signals, completely illustrated and indexed. It's yours, FREE for the asking. Let it help you increase your signal business!

FARADAY

KODAIRES, HORNS, BELLS, CHIMES
all fit the same UNI-PACT plate

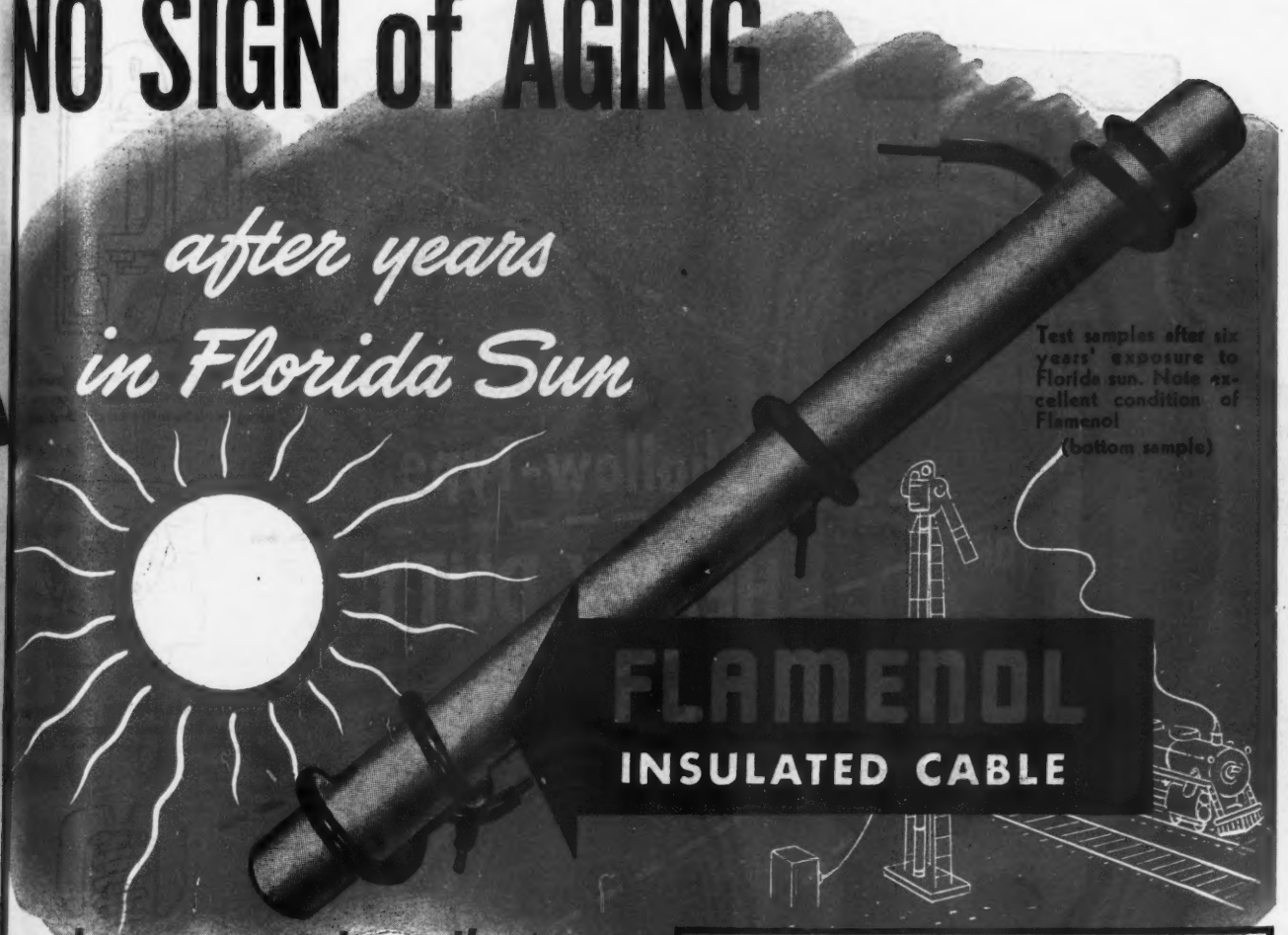


The UNI-PACT Safety Dead Front Adapter Plate is part of each UNI-PACT signal assembly. With UNI-PACT, you can change signals as conditions change in any part of your plant —easy as plugging in a toaster! Full details in our catalog.

FARADAY ELECTRIC CORPORATION
A consolidation of Schwarze Electric Co. and Stanley & Patterson
ADRIAN, MICHIGAN

NO SIGN of AGING

after years in Florida Sun



Test samples after six years' exposure to Florida sun. Note excellent condition of Flamenol (bottom sample)

Long exposure to weather proves value of G-E synthetic cable for outdoor applications

In 1937, a large railroad operating in the South decided to compare the aging qualities of various cable insulations. Line drops of three types of cable—one had an oil-base rubber insulation, one had a mineral-base rubber, and one was Flamenol*—were installed. None of the cables was braid covered—in each case the insulation was exposed to sun and weather.

After six years' operation, the samples were removed for inspection. As shown in the photograph above, the insulation on two of the samples had aged considerably, but the Flamenol was still in excellent condition.

Flamenol—the pre-Pearl Harbor synthetic-insulated cable

When war broke out in Europe, millions of feet of Flamenol cable already had been installed in automotive, chemical, food, textile, and other plants, as well as in mines and oil refineries, and on railroads.

For wiring installations subjected to acid, alkaline, oily or moist conditions, fire hazard, or weather, Flamenol is the *proved-performance* cable. Note, at right, its operating, installation, and maintenance advantages. For complete information, ask our local office, or write to *General Electric Co., Schenectady 5, N. Y.*

11 BIG ADVANTAGES offered by FLAMENOL

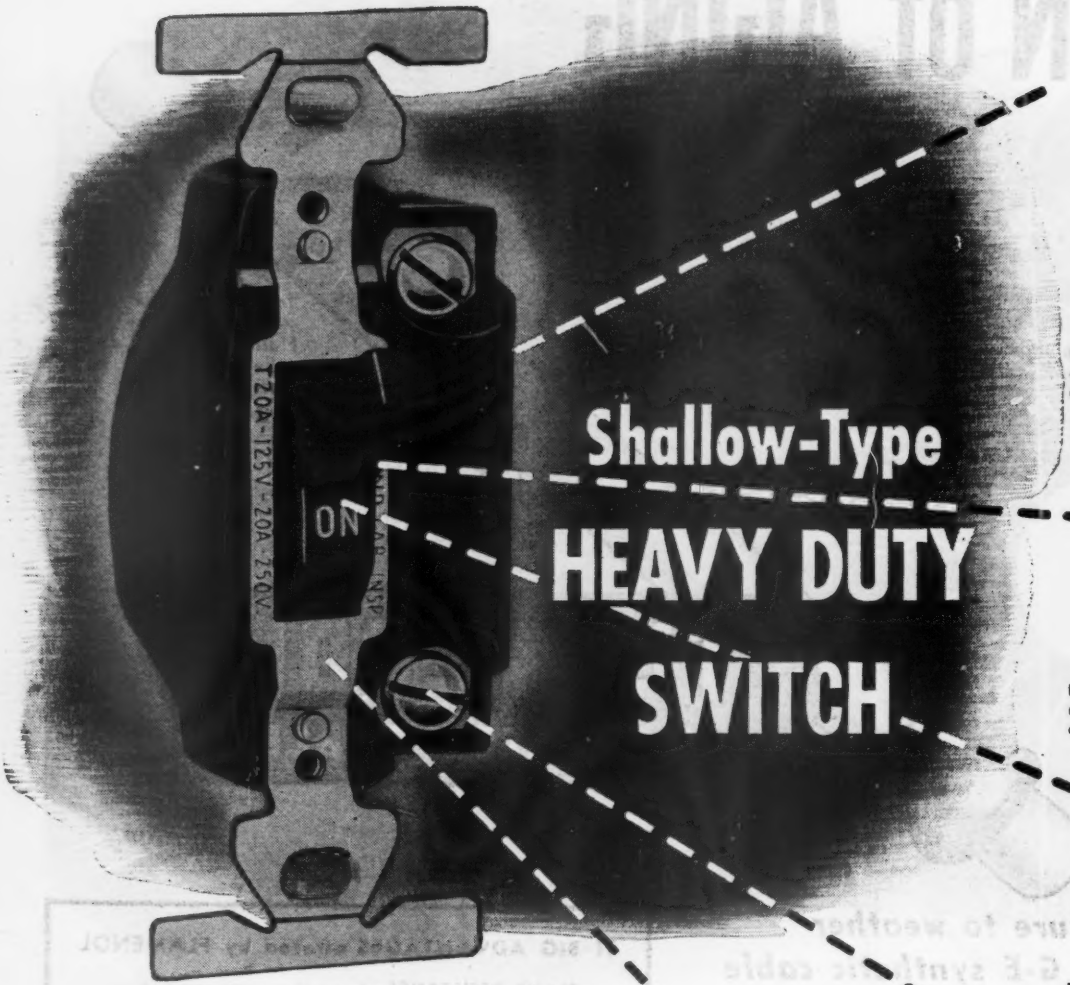
1. **FLAME RESISTANCE**—does not support combustion.
2. **CORROSION RESISTANCE**—immune to action of oils, acids, alkalies.
3. **SUPER-AGING**—does not oxidize. Highly resistant to sunlight and weathering.
4. **EXCELLENT PHYSICAL PROPERTIES**—has minimum tensile strength of 1500 lb per sq in., minimum elongation of 100 per cent.
5. **DIELECTRIC STRENGTH**—retained at about 720 volts per mil through severe operating conditions.
6. **SMALL DIAMETER**—saves space, facilitates wiring.
7. **SMOOTH SURFACE**—facilitates pulling through conduit.
8. **FREE STRIPPING**—speeds splicing, avoids nicking conductors.
9. **DIFFERENT COLORS**—simplify circuit tracing.
10. **VARIOUS CONSTRUCTIONS**—aid selection for special applications.
11. **SELF-PROTECTING FINISH**—eliminates need for braid, less space required.

*Reg. U.S. Pat. Off.

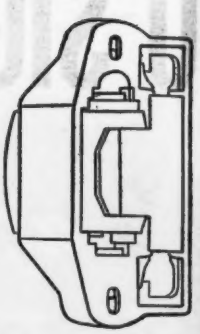
BUY WAR BONDS

GENERAL ELECTRIC

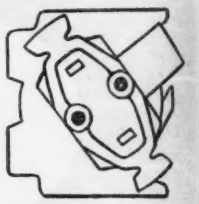
502-14-1200



Shallow-Type HEAVY DUTY SWITCH



BAKELITE CASING fully encloses m... anism. Extra thick walls survive h... dling impacts and exclude dust and d...

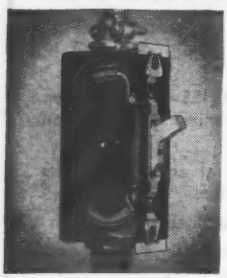


RUGGED MECHANISM of heavy-ga... metals withstands repeated use a... abuse, assures trouble-free operati...

HEAVY SPRING of carefully tested spri... wire assures positive switch action b... tens of thousands of cycles.

POSITIVE CONTACT provided b... doubled-sided blades of selected spri... bronze, shaped and adjusted to "mak... and "break" contacts simultaneous...

STURDY YOKE has integral plaster ea... for aligning flush with wall, or can... broken off if not needed. Complete... insulated from mechanism.



SHALLOW DESIGN *permits installation in 1½ inch deep box, with adequate space for easy wiring*

The Bryant 5861 switch is "T" rated at 20 amperes, built to carry the heaviest demands of the rated load. Every part in the switch is made of the strongest materials available, assuring you of a shallow-type switch capable of withstanding tough service. Note the details of Bryant construction and design as shown here.

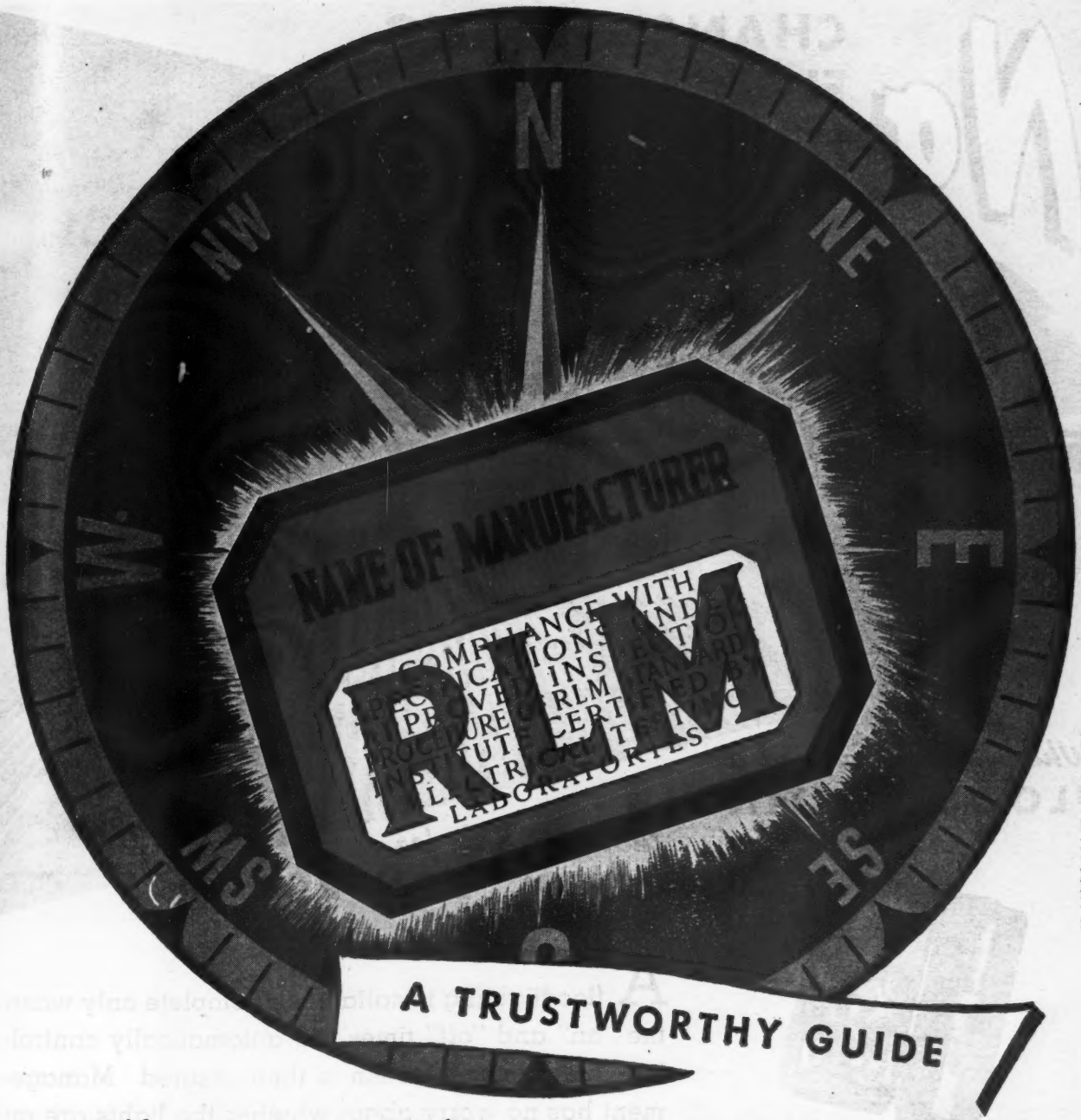
BRYANT
SUPERIOR WIRING DEVICES

Specify Bryant Devices from your Electrical Wholesaler

ARMY E NAVY

THE BRYANT ELECTRIC COMPANY
BRIDGEPORT, CONNECTICUT

NEW YORK
CHICAGO
SAN FRANCISCO
LOS ANGELES



TO *Efficient* AND *Effective* INDUSTRIAL LIGHTING

Today it is a simple matter to be sure of dependable design and construction in industrial lighting fixtures. Look for the RLM Label. It certifies that the unit has been made in accordance with RLM specifications, under the rigid system of inspection maintained by RLM Standard Institute.

The RLM Standard Institute does not manufacture lighting equipment. It is a non-profit organization, which operates to develop and promulgate specifications for the efficient performance of industrial lighting equipment.

The RLM LABEL is a certificate of performance to these specifications certified by an independent testing laboratory. It has come to symbolize these four essentials of a good industrial lighting installation: (1) Engineered Lighting, (2) Economy through More Light At No Extra Cost, (3) Low Maintenance Cost.

For dependable guidance on vital construction and performance factors for both Incandescent and Fluorescent Lighting Units, write for RLM Standard Specifications. Address your request to any manufacturer utilizing RLM inspection and certification, or direct to RLM Standards Institute.

The Letters RLM Stand for Reflector and Lighting Equipment Manufacturers

RLM STANDARDS INSTITUTE
INCORPORATED
307 NORTH MICHIGAN AVENUE • SUITE 420 • CHICAGO 1, ILLINOIS

SANGAMO TIME SWITCHES

• There are types to meet every protective lighting control need. The complete line includes Astronomic Dial, Synchronous Carry-Over, and Outdoor Time Switches. Form VSW2 Astronomic Dial Time Switch is shown above. Current interruptions up to 10 hours will not stop it nor affect its "on" and "off" settings.

ARMY E NAVY

A floodlighting installation is complete only when the "on" and "off" times are automatically controlled. Full time protection is then assured. Management has no worry about whether the lights are on or whether some one may err in turning them off.

In this matter you become an important factor. You have exceptional sales arguments that are immediately convincing. The men who buy floodlighting can't help but see the insurance value of SANGAMO TIME SWITCHES.

In addition to those new floodlighting installations you are working on you'll find it profitable to go back over past installations and tell them about SANGAMO TIME SWITCHES.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

FREE ENTERPRISE

The Obligation of Management and Labor to Cooperate... in War... in Peace

The Invasion is on! We have unleashed our full might for military victory. We have confidence that our great strength will bring success. We are strong because we have achieved unity in mobilization and in combat.

Though victory appears assured, we cannot rest until we have done everything in our power to speed the day when death and destruction are halted.

The home front is an important factor in this time element, for the fighting power of our Armed Forces depends upon their weapons. Napoleon's army fought "on its stomach"—man against man. Eisenhower's men fight on their tonnage—tanks, artillery, machine guns, heavy bombers.

As never before in the long succession of wars, the legends of heroic deeds on the battlefronts in this world conflict will be paralleled in history by the great accomplishments on the production fronts. Along with these heroic achievements of our Armed Forces, the world will long remember the record of our production accomplishments which have made us the stongest military power in the world, as well as the arsenal of democracy.

As the conflict reaches its climax, as battles grow fiercer and more destructive, our responsibility becomes greater and more critical. We must coordinate our productive efforts with the same ingenuity and the same precision with which our Armed Forces have coordinated theirs. We dare not waste the productivity of a single man or machine in these critical days.

As our landing craft are discharging our fighting men on the beaches of Europe and the Pacific, they must not want for equipment. No interference with war production for any reason can be justified. There must be no picket lines in America!

The landing of American troops in France virtually has stopped all strikes in the United States. This is important and encouraging news because the prelude to invasion, unfortunately, has been an epidemic of strikes. Time lost through strikes, during the first four months of 1944, was double that lost during the same period last year. April saw more strikes than any other month since Pearl Harbor, and in May the record again was broken. Here is what happened within two weeks in May:

> Nine thousand men in six Chrysler plants in Detroit were out when a jurisdictional dispute in a "soda pop" war between the American Federation of Labor teamsters and the Congress of Industrial Organizations fired their discontent.
>
> A three-day sit-down strike occurred among 950 employees in the B. H. Aircraft plant over the refusal of the company to discharge a superintendent unsatisfactory to the union.
>
> Thirteen hundred men in the Chevrolet transmission and axle plant at Saginaw struck over a no-smoking rule and a change in shift-starting time.
>
> Two thousand employees at the Browne and Sharpe Manufacturing Company walked out when a woman was hired to fill a job long held by a man.
>
> Production of penicillin, blood plasma, and other medical supplies was halted at two Detroit plants of the Parke Davis Company as 1900 employees struck for a ten-cent raise.
>
> Over 25,000 lumber workers in the Pacific Northwest struck because the War Labor Board denied their demand for a wage increase.

At the end of the third week of May, 70,000 workers in 26 plants in Detroit were idle because of strikes.

Strikes in Detroit alone reduced production as much as a moderately successful German air raid would have done. Far more important than their effect on output is the effect of strikes upon national unity and morale. To our home front and to our Armed Forces, strikes belie our pledge to back the attack with all the power at our command. Hence, strikes limit our all-out war effort.

Prompt and decisive action is needed to keep America free from strikes for the remainder of the war. Stoppages of work on the production lines cannot be condoned while lives are being lost in fighting the enemy.

Most union leaders realize this need and are preparing to impose discipline upon their members who violate the no-strike pledge. The Warehouse Division of the International Longshoremen's and Warehousemen's Union (C.I.O.) recently declared: "Strikes in this time of war are treason against the nation and betrayal of the interests of labor." A message sent by William Green to all heads of American Federation of Labor unions stated:

> "D-day is here. From now on until Hitler is finally crushed, every worker enrolled in the army of production must consider himself a part of the invasion forces of the United States and conduct himself accordingly. I call on you in the name of the American boys who are risking their lives under enemy fire to maintain uninterrupted production under any and all circumstances. Until victory is won every worker must give the same all-out service that our Armed Forces are giving on the field of battle."

Strongest of all was the appeal of R. J. Thomas, president of the United Automobile Workers, to members of his union:

> "Our union cannot survive if the nation and our soldiers believe that we are obstructing the war effort . . . there can be no such thing as legitimate picket lines . . . I appeal to our membership. If you value your union, if you want to live and serve after the war, we must restrain ourselves and our hot-headed brothers today. If we do not, there will be no union after the war."

Union officers are entitled to vigorous support from management and government in their efforts to prevent strikes. Behind many a strike is an accumulation of unsettled grievances. Managements are overworked, and many union shop stewards are new and inexperienced and do not always do their part in turning down cases which lack merit. Both of these conditions make it easy for large backlogs of unsettled grievances to pile up. A special drive to clean up unsettled cases and to prevent new accumulations of them is one way by which managements and local union officials can help shorten the war.

The government too has a contribution to make to the prevention of strikes—both through the prompt disposal of disputes and through firm action against the leaders of strikes. The National War Labor Board and the Regional Boards are disposing of over five thousand cases a month and have made an excellent record in reducing their backlogs. Nevertheless, the boards still have many old cases; and about one out of four strikes has been an effort to get action from one of the labor boards. The boards are entitled to cooperation from employers and unions in keeping down their docket. In instance after instance, cases are dumped in the lap of the board before the union and employer have made a real effort to get a meeting of minds and to work out settlements.

In the present emergency, strikes are an expression of the lack of adequate understanding and team work between unions and management. Any future great upsurge in industrial strife likewise will be due to misunderstanding. After this war this country must not go through another "1919" when the time lost from strikes reached an all-time high. With 13 million workers, or almost half of the non-salaried employees of the country, in trade unions, the power and prestige of unions is greater than ever. ***The long-run prosperity of the country requires that business and labor learn how to cooperate in supporting the policies which produce the largest possible profits and the largest possible payrolls.***

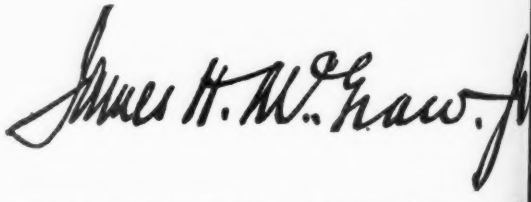
Although business is primarily interested in the largest possible profits, and labor is primarily interested in the largest possible payrolls, both objectives call for the same basic conditions. Payrolls depend upon the prospects for profits. If bad relations between business and labor or unwise public policies cause employers to take a pessimistic view of the outlook for profits, both employment and payrolls will be depressed.

Individual unions and individual employers always will have differences over wages and hours and the status of labor in particular plants or in particular occupation Some disputes on such issues are inevitable, but reso to arbitration and calm intelligence can help greatly avoiding strikes in the long run. Cooperation betwee labor and management is an economic necessity. In o kind of economy, payrolls and profits ***both depe upon the willingness and the ability of business a labor to work together in creating the conditions u der which enterprise flourishes.***

The foundation for intelligent and effective coope tion must be accomplished by skillful and imaginati managers in plants throughout the country who are wi ing to help unions with their problems, and who are ab to interest union leaders and their members in t problems of business. Union members and their leade are keenly interested as a rule in the efforts of manag ment to win new markets. They know that jobs depe upon the success of managements in improving t product, adding new items to the line, and, less frequen ly, cutting costs and prices. Employees like to be ke informed about what management is doing, what pro lems it is meeting, and what success it is having. Mo of all, they like to have an opportunity to contribu their ideas and suggestions.

The recent epidemic of strikes should not blind us the fact that even today there are more plants whe managements and unions are on good terms than ev before in the country's history. Consider, on the o hand, the extensive and constantly growing efforts unions to train and develop shop stewards and, on t other hand, the efforts of employers to teach foreme how to carry out the new responsibilities imposed up them by union agreements. Unions and managemen together are learning how to operate together such tec nical devices as time study and job evaluation. Manag ments which, several years ago, opposed the provision umpires to interpret union agreements and to sett deadlocked cases today are taking the lead in suggesti such arrangements.

The war is reaching a crisis, and all groups in t country must be aware as never before of their co mon interests. This presents an opportunity whic should be seized to lay the permanent foundations f more effective team work in American industry. Let hi tory record that the days when Europe was being li erated also were the days when unions and employe were making unprecedented progress in preparing Am ican industry for the return of the service men by d veloping policies of cooperation between business a unions. Such cooperation will help achieve a pea worthy of our efforts and our sacrifices.



President, McGraw-Hill Publishing Company, I

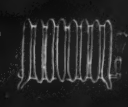
WHETHER YOU USE IT OUTDOORS

WHERE IT'S EXPOSED TO THE WEATHER

OR INDOORS

WHERE IT'S WARM

AND DRY

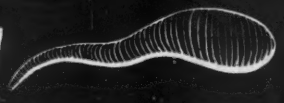


OR UNDERGROUND

WHERE IT'S ALWAYS DAMP

YOU'LL FIND GOLD SEAL FRICTION TAPE

STICKS LIKE A



LEECH

HERE'S WHY-- If there's one quality users want in tape more than any other, it's *tackiness* – the ability to "stay put" wherever it's used. And tackiness is where Gold Seal Friction Tape shines! It sticks to the job like an umpire clinging to a close decision!

Gold Seal's tackiness comes from a formula developed by Jenkins Bros. Rubber Research Laboratories after months of testing. This compound of extra adhesive strength *coats both sides* of a fine quality base cloth. That's why Gold Seal Tape doesn't "peel" or dry out like ordinary tape . . . why it handles right and sticks tight right down to the last tenacious inch of the roll.

Gold Seal is sealed fresh in cellophane . . . carried by good supply houses . . . made by Jenkins Bros., Rubber Division, 80 White St., New York 13, N. Y.

JENKINS

Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet ASTM and Federal specifications.

Gold Seal Tape

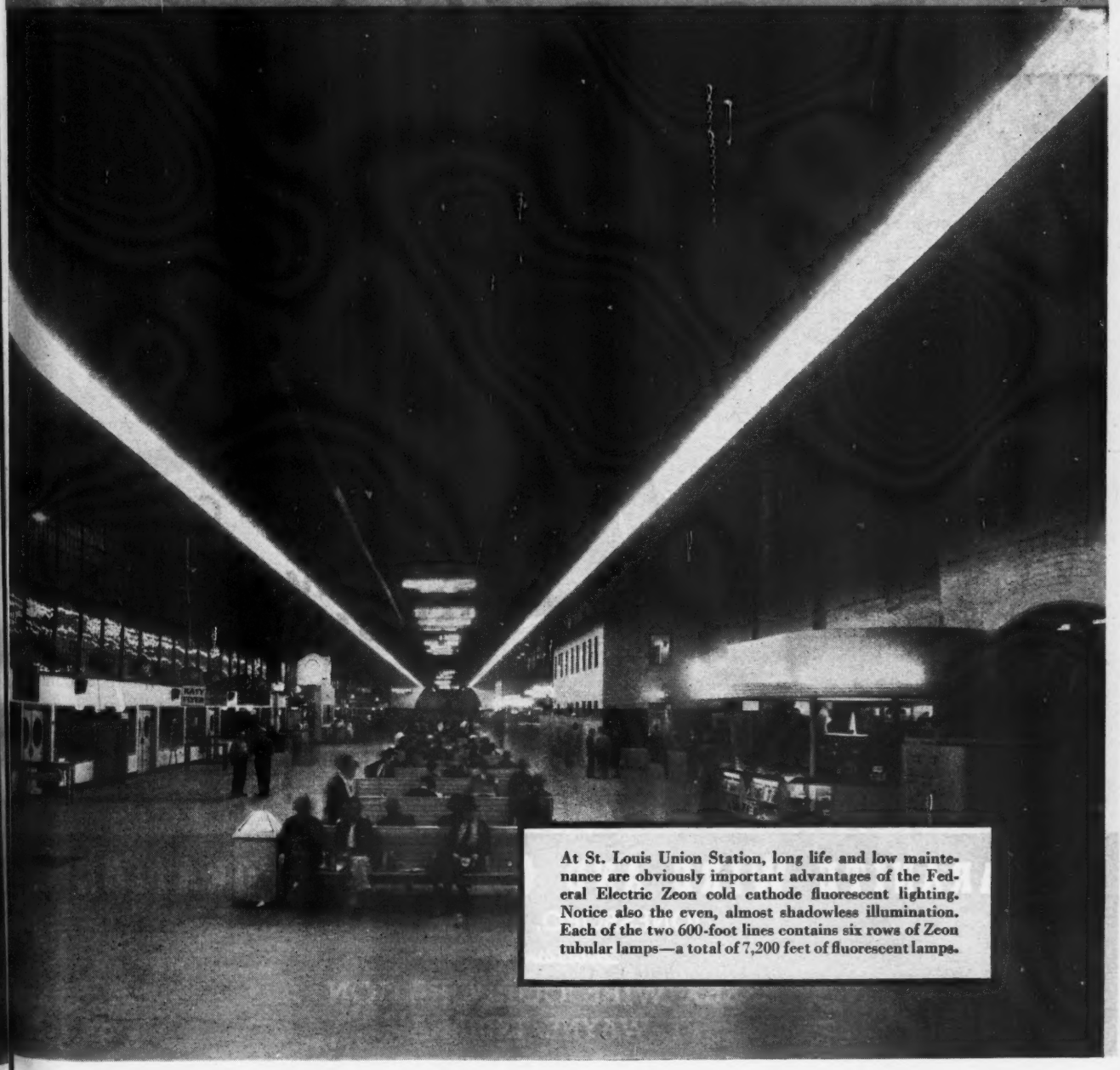
FRICTION and RUBBER TAPES

MADE BY JENKINS BROS. . . . MAKERS OF FAMOUS JENKINS VALVES

But there are 2 Kinds of Fluorescent Lighting ...For most applications

Cold Cathode is Best

- ★ LONGER LAMP LIFE
- ★ LOWER MAINTENANCE COST
- ★ INSTANT STARTING
- ★ CONSTANT LIGHT FLOW
- ★ FEWER AUXILIARIES
- ★ GREATER FLEXIBILITY



At St. Louis Union Station, long life and low maintenance are obviously important advantages of the Federal Electric Zeon cold cathode fluorescent lighting. Notice also the even, almost shadowless illumination. Each of the two 600-foot lines contains six rows of Zeon tubular lamps—a total of 7,200 feet of fluorescent lamps.

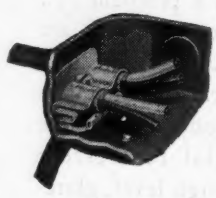
MANY successful contractors throughout America prefer the Raco • All-Steel • Line. They know, from experience, that Raco is the mark of better workmanship, finer materials . . . that Raco is the dependable line that is accepted by architects and builders . . . that Raco products help win approval of their work.

More than 31 years of engineering and product improvement have kept Raco • All-Steel in step with the latest developments in the electrical wiring field, have provided better products for all types of construction: new and old building, repair and maintenance jobs. Raco • All-Steel has been in use for years on many of the nation's largest and most technical jobs.

Remember . . . you can always RELY on RACO! Look for the Raco trade-mark. It's the quality line that is attractively packaged and *sold only through wholesalers.*

COB½—The Popular "C O", 4" Square Box with a convenient bracket.

DO-21-N3 — Completely protects non-metallic cable entering through side or bottom. Clamp is one piece.



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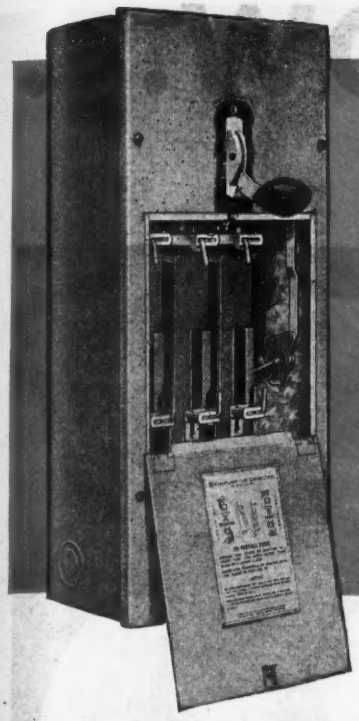
ALL-STEEL-EQUIP COMPANY, INC.

600 Kensington **Aurora, Illinois**



Current "ON"— hands "OFF" live contacts

The switch must be OFF before the door can be opened. Thus, protection against live parts is assured by the Type A

SHUTLBRAK SWITCH

These switches may be used singly — banked in groups — assembled in well-designed switchboards or panelboards — or installed as plug-in units on Ⓕ Busduct ... On motor circuits — at service entrance — or on installations requiring an operating switch — they give efficient dependable service.

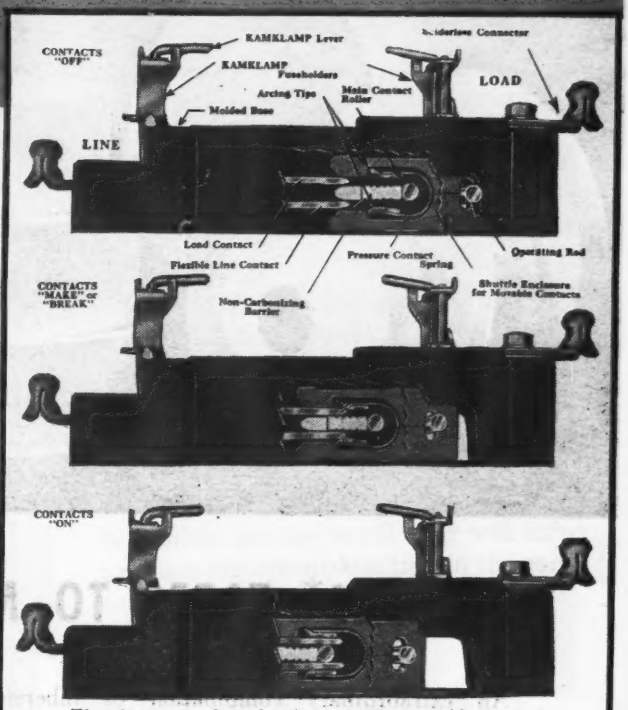
The Ⓕ Shutlbrak Switch is unique in that the contacts are *shuttled* on and off — with the roller type main contact and the auxiliary contacts enclosed in an insulated shuttle. This shuttle assembly, in turn, is entirely surrounded by insulating material.

Ⓕ Kamklamp (pressure type) Fuseholders take either ferrule or knife-blade types of fuse terminals. The new Ⓕ Solderless type Pressure Connectors assure perfect contacts.

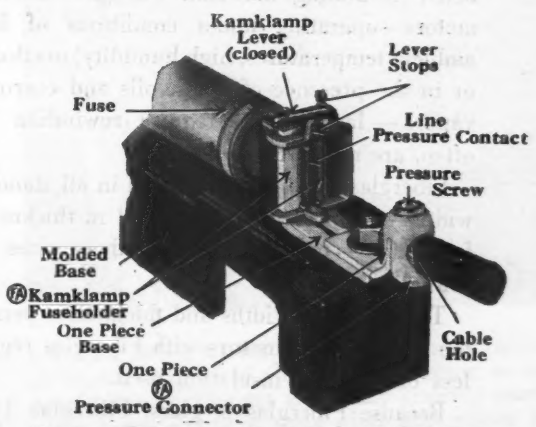
Capacities: 30 to 1200 amperes, inclusive, for 250 volts AC or DC, and 575 volts AC, in 2, 3 and 4 pole types ... Approved by Underwriters' Laboratories, Inc.

For detailed information

and suggested specifications for Ⓕ Shutlbrak Switches, Switchboards and Panelboards, write for illustrated Bulletin 70 ... Frank Adam Electric Company, Box 357, St. Louis (3), Mo.



The above cuts show details of shuttle assembly, contact design, and Ⓕ Kamklamp Fuseholders.



Details of Ⓕ Kamklamp Fuseholders and Ⓕ Solderless Type Pressure Connector.

Frank Adam
ELECTRIC COMPANY
ST. LOUIS

AVAILABLE NOW...

FIBERGLAS* TAPES TO MEET EVERY WINDING NEED

An extraordinary combination of inherent qualities makes impregnated Fiberglas Tape a better insulating material. Fiberglas-insulated motors—operating under conditions of high ambient temperatures, high humidity, overloads, or in the presence of acids, oils and corrosive vapors — last longer, require rewinding less often, are more economical.

Fiberglas Tapes are produced in all standard widths—from ⅜" to 1½"—and in thicknesses from .003" to .015". All of these sizes are available now!

This range of widths and thicknesses permits the rewinding of motors with Fiberglas regardless of previous insulation used.

Because Fiberglas is glass, Fiberglas Tapes provide an inorganic insulation of exceptional value in electrical applications.

The individual glass fibers are nonhygroscopic—a property of major importance in many electrical applications.

Some of the other superior benefits Fiberglas Tapes offer are: great tensile strength; high temperature resistance; high dielectric strength and insulation resistance when combined with appropriate varnishes or impregnants.

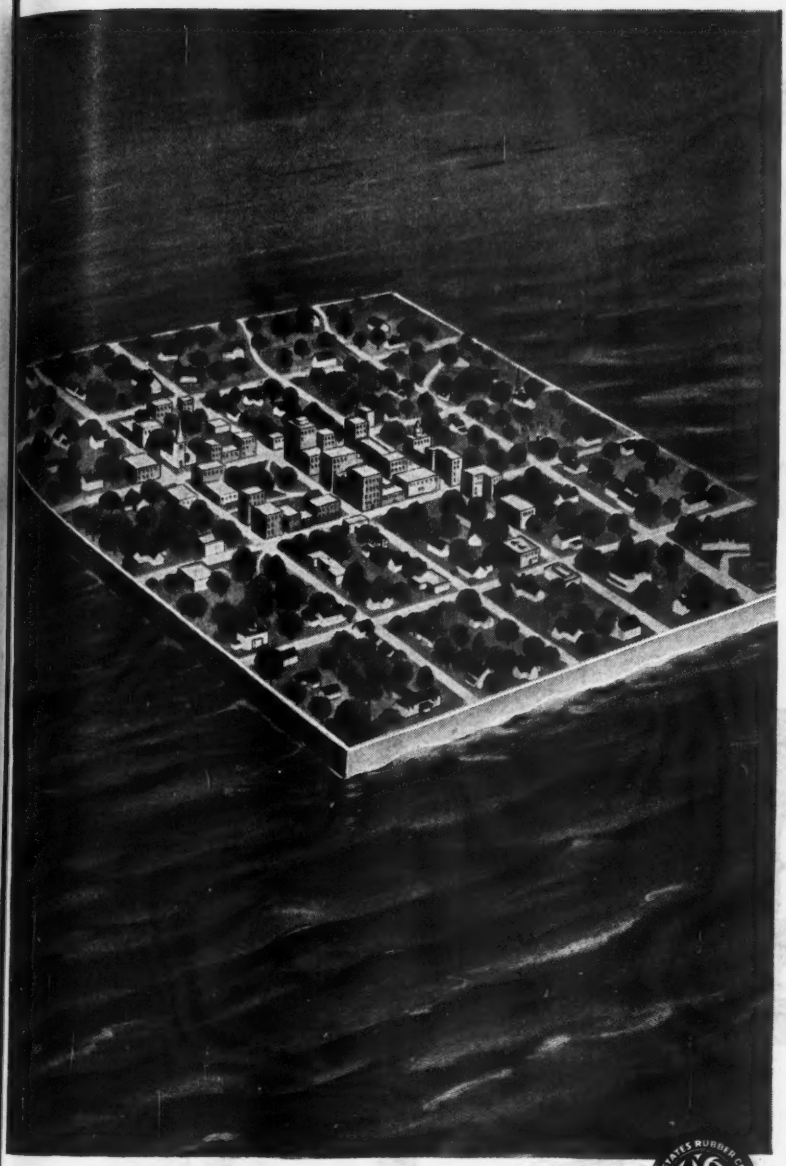
For full information or samples of the complete line of Fiberglas Electrical Insulation, consult your distributor or write *Owens-Corning Fiberglas Corporation, 1856 Nicholas Bldg., Toledo 1, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.*

ARMY E NAVY

FIBERGLAS ...A BASIC MATERIAL

*T. M. Reg. U. S. Pat. Off.

YARNS • TAPES • CORD • SLEEVING • CLOTH AND OTHER FORMS



WIRING A FLOATING CITY

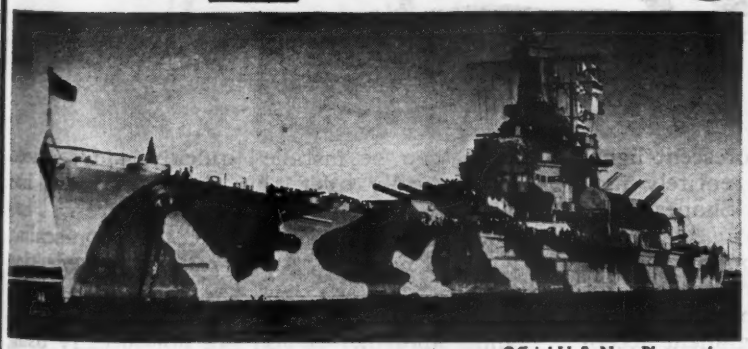
A super-dreadnaught at sea is a self-contained, highly co-ordinated community. It takes close to a million feet of insulated wires and cables for the amazing network connecting the many telephones, head-sets and loudspeakers.

Insulations of special compounds developed by U. S. Rubber scientists provide effective protection for communication and power lines. They retain their resiliency under continued vibration and the shattering shock of big guns firing.

Among these is Laytex, a compound of purified ingredients. Applied to the wire by a unique process of dipping and drying followed by vulcanizing, it forms a homogeneous sheath around perfectly centered conductors.

U.S. Laytex Wires and Cables now in combat use the world over will have a no-less important function in the communities of the future.

Laytex WIRES AND CABLES — *SERVING THROUGH SCIENCE*



Official U. S. Navy Photograph

188 MILES OF WIRE: That's what the communications system alone on the latest super-dreadnaught requires. Laytex Wires and Cables—slender, yet tough because of their special insulation—are in use on such systems as they are elsewhere with our Armed Forces around the world. Other types of U. S. Laytex Wires and Cables are used for gun control, lighting and power.

LAYTEX WILL COME HOME: The entire output of Laytex Wires and Cables is still going to the Armed Forces. The day is steadily drawing nearer when manufacture of these wires and cables for Buildings, Police and Fire Alarms, Communications, Signalling, Power and Control will be resumed.

Listen to the Philharmonic-Symphony program over the CBS network Sunday afternoon, 3:00 to 4:30 E.W.T. Carl Van Doren and a guest star present an interlude of historical significance.

UNITED STATES RUBBER COMPANY

1230 SIXTH AVENUE, ROCKEFELLER CENTER, NEW YORK 20, N. Y. • *In Canada:* DOMINION RUBBER CO., LTD.

THIS "PINCH HITTER" IS NOW A REGULAR

WHEN the use of metal for fluorescent lighting fixtures was restricted, an entirely new product—Masonite* Reflector Shapes—was sent in as a "pinch hitter."

Today, these streamlined, non-metallic reflectors have scored such a tremendous hit that they now are definitely on the "regular team"! Yes, they have won permanent acceptance by manufacturers throughout the country. More and more men in industry have discovered that these unique hardboards offer very distinct advantages.

Masonite Reflector Shapes weigh amazingly little. They're easy to handle, cut shipping costs, can be installed quickly and serviced economically. Yet this dense material has rugged strength . . . resists moisture . . . has low electrical conductivity . . . is non-scaling . . . will not rust. And it takes fine reflecting finishes easily.

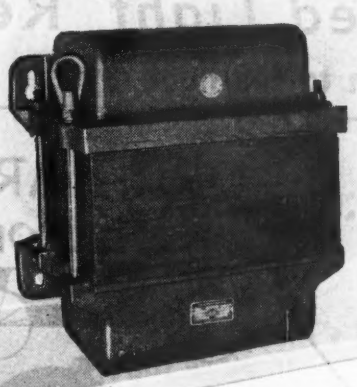
Here is the new lighting fixture of today—and tomorrow! If you are not already using these modern, money-saving reflectors, now is the time to give them a trial. You, too, will find them worthy of a permanent place in your plant. For complete details, please write Masonite Corporation, 111 W. Washington St., Chicago 2, Illinois.

MASONITE CORPORATION

Awarded to the Masonite Corp. Plant at Laurel, Miss.

*TRADE-MARK REG. U. S. PAT. OFF. COPYRIGHT 1944, MASONITE CORP.

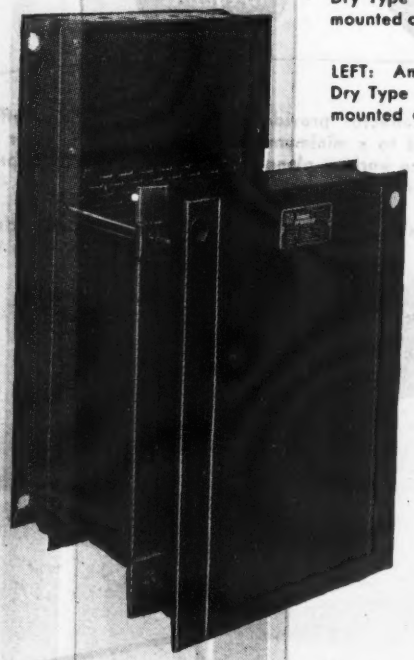
STOP MOTOR STARVATION



WITH AMERTRAN DRY-TYPE TRANSFORMERS AT LOAD CENTERS

ABOVE: AmerTran CF Dry Type Transformer mounted on an I Beam

LEFT: AmerTran WF Dry Type Transformer mounted on pillar



When motor relays kick out, overload is not always the cause. Such motors may be underpowered because long secondary feeders or other load centers have robbed them. Yet these outages can be corrected or forestalled and substantial copper savings effected—by stabilizing load center power distribution with AmerTran Dry-Type Transformers.

No disturbance of existing equipment is necessary. Eye beams or pillars close to the work can furnish mounting because AmerTran Dry-Type Transformers are unusually small and light for their conservative ratings. Comprising both standard and special types, they are available in a wide range of ratings and for many applications. If desired, Class B insulation may be specified. Write today for descriptive literature.

AMERICAN TRANSFORMER CO. 178 Emmet St., Newark 5, N. J.

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

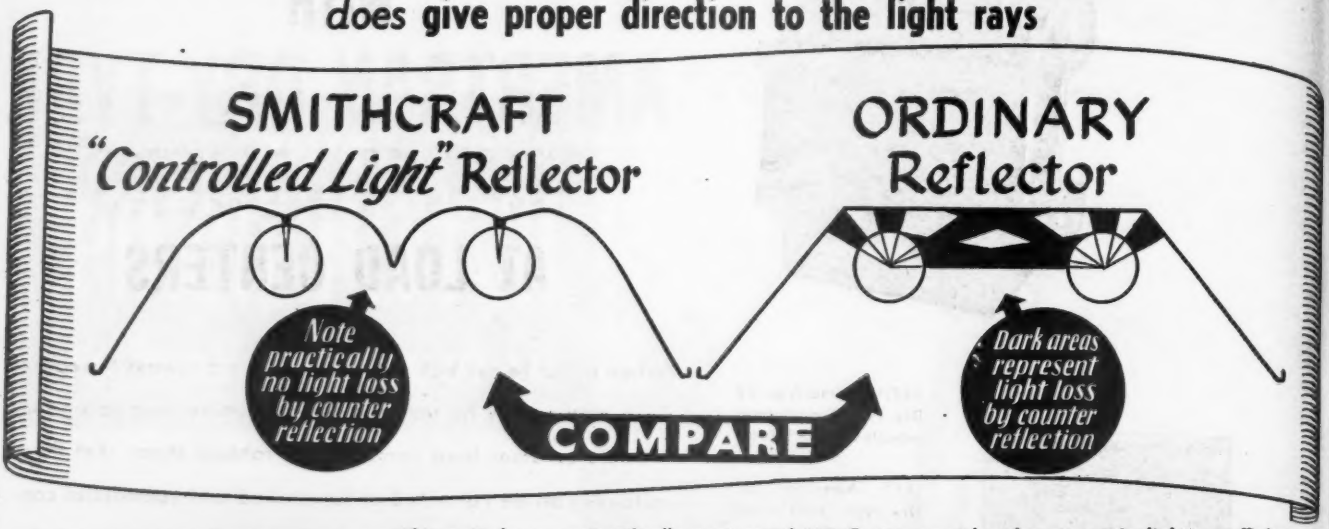
AMERTRAN

Light rays can CHEAT

unless they are brought out of hiding and properly directed

The NEW SMITHCRAFT "*Controlled Light*" Reflector

does give proper direction to the light rays



This entirely new scientifically engineered V-Reflector provides the utmost in lighting efficiency and output. Light loss is reduced to a minimum. Controlled light reflector directs maximum light to the working plane—actual foot candle tests prove its greater effectiveness.

Send for full details of this outstanding fixture development—and your next installation will be Smithcraft.

This new conception in lighting by Smithcraft will give you the utmost in customer satisfaction. Mechanical excellence all-steel for strength—wide variety of mounting methods—new captive-turn positive reflector fastener or release—Supercoat finish, baked or porcelain enamel—simple installation and easy maintenance—all these and more available with the new Smithcraft Industrial Fluorescent line. No wonder the Swing to Smithcraft is nation-wide!

A COMPLETE FLUORESCENT LINE

Industrial units for individual and continuous row mounting. Also smartly styled commercial units.

All 2-40 and 2-100 industrial and commercial fixtures are available with LIGHTNING START.

A. L. SMITH IRON CO., Chelsea 50, Mass.

Conserve

YOUR TOLEDO DIES!

Resharpen

TO KEEP 'EM CUTTING 5 TO 100 TIMES LONGER!

● Your Toledo Dies and Cutters can be resharpened again and again—if you don't neglect them. This means—have your dies, cutters and reamers *ground* when dull—don't throw them away and don't use them until they chip.

If sharpened, instead of thrown away when dull, your Toledo Tools will produce 5 to 100 times as much work. This saves steel for the war effort—and saves money, too. If you have not the facilities to resharpen your Toledo dies, cutter knives and reamer heads, return them to us. Our charge will be moderate. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office, No. 2 Rector Street.

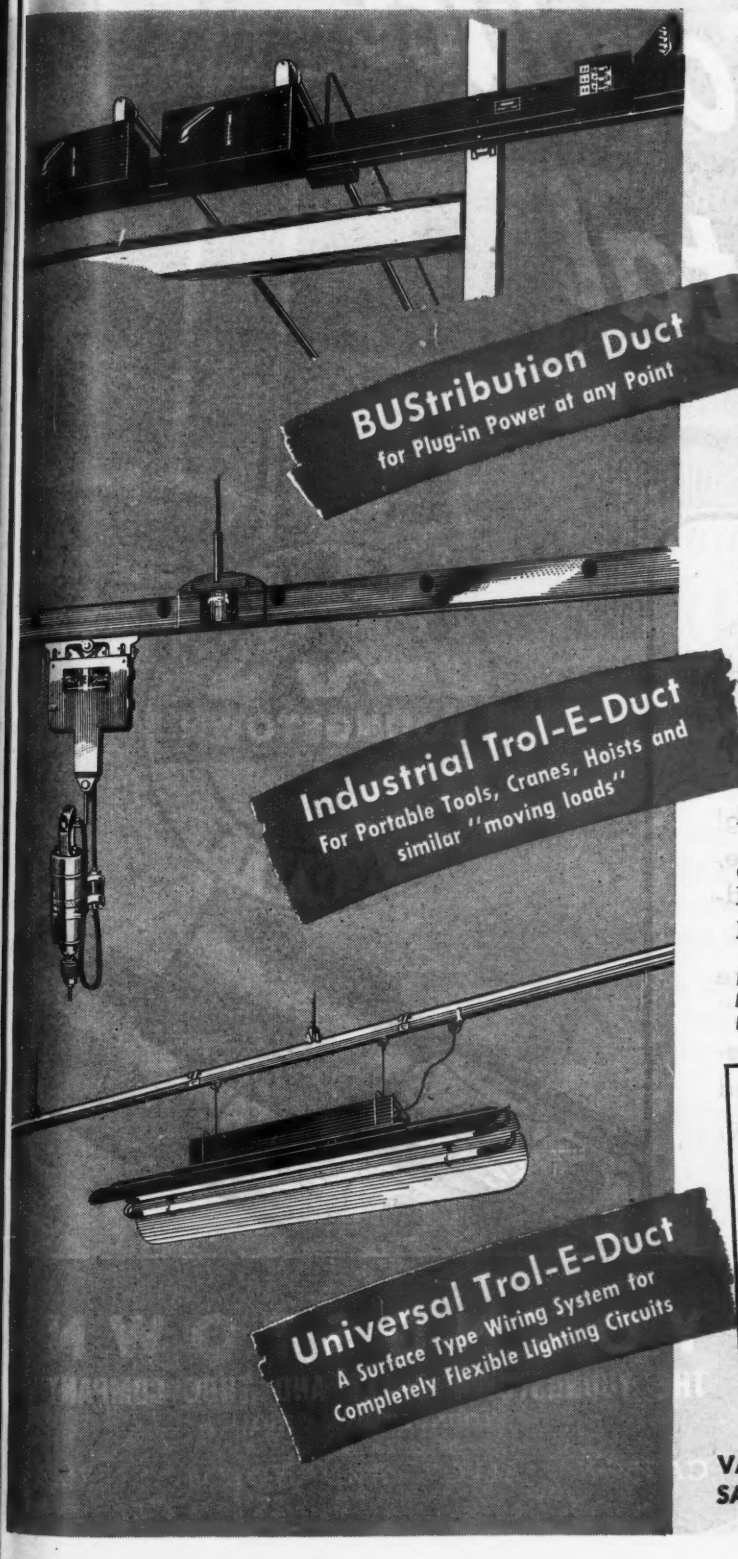
TOLEDO

PRECISION PIPE TOOLS

3505 BULLDOG INSTALLATIONS

In America's Largest Manufacturing Plants

WILL SPEED RECONVERSION



BullDog Duct . . . for power and light . . . will help in Peace Production Race

In thousands of *major* U. S. war plants, new and old, BullDog Electrical Systems have saved countless hours on installation and maintenance — greatly reduced changeover time — helped keep production at top speed and efficiency.

How? By making plug-in power immediately available for any shop set-up. By bringing power close to portable tools on any type of production line. By putting light close to the work on any kind of operation.

An Asset in the Postwar Race

When these BullDog-equipped plants get the go-ahead for reconversion they will again be out in front in the production race — and for the same reasons. Their flexible electric systems will be ready for even the most sweeping changes of product, plant layout or tool set-up.

To manufacturers—large or small—who have not yet installed this modern method of power and light distribution, BullDog offers the services of expert field engineers, to help in planning postwar operations.

Write now for complete descriptive material on BullDog BUStribution DUCT, Universal Trol-E-Duct, Industrial Trol-E-Duct and other BullDog products.

Buy Bonds to the Limit in the Fifth War Loan

BULLDOG
ELECTRIC PRODUCTS CO.

BOX 177, R. PK. ANNEX
DETROIT 32, MICHIGAN
BullDog Electric Products of Canada, Ltd., Toronto, Ont.

Field Engineering Offices in All Principal Cities

ALSO MANUFACTURERS OF
VACU-BREAK SAFETY SWITCHES • SWITCHBOARDS
SAFTOFUSE PANELBOARDS • CIRCUIT MASTER BREAKERS

As the Pace of Business Quickens

LOST HOURS
more than ever mean
LOST DOLLARS

KILLARK FITTINGS are designed for fast, easy installation so that there is no lost time with dollars wasted.

KILLARK FITTINGS are made with "flat backs" and that's a thing of importance to contractors. Consider these advantages—KILLARK FITTINGS lay flat and stay put—they are easier to install and eliminate a lot of worry and bother — contractors are money ahead after each installation. KILLARK FITTINGS have greater strength and are lighter in weight. The line includes flush switch fittings, vaporproof light fittings, and explosion-proof fittings for hazardous locations. They are stocked in thirteen major cities.

QUICK EFFICIENT DELIVERY OF
KILLARK FITTINGS
NOW BECOMES INCREASINGLY IMPORTANT TO YOU

The fact that you can get all types of KILLARK FITTINGS quickly means that you can have immediate advantage of these modern fittings with the cost savings that come with each installation.

There are more than 2500 fittings in the KILLARK Line and they help in making each job a good appearing one.

Ask for the* KILLARK *Catalog.

K KILLARK ST. LOUIS

Killark

ELECTRIC MANUFACTURING CO., ST. LOUIS 13, MO.

CONDUIT FITTINGS

IF you're not interested in bargains . . . or don't care to get "more for less"

don't read this ad

This ad—second in a series on "De-ion" (fuseless) Circuit Breakers for 1944—is addressed to those men in American industry who are genuinely interested in bargains . . . who insist on the best . . . who demand more for less.

Every industry, large or small, has a great portion of its working capital invested in electrical equipment served by 220, 440, or 550-volt circuits. This includes motors, welders, compressors, machine tools.

One of the main keys to industrial profit, therefore, lies in keeping this equipment working on a continuous production basis, minimizing extended shutdowns or damage from overloads or short circuits.

This overload and short circuit protection can be secured through the use of a wide variety of devices. And—that's where the "bargain"—or how to get "more for less" comes in. For, most of these devices—while affording adequate protection—certainly aren't designed for the man who wants the best. Nor are they bargains.

They do the job—there's no doubt about that. But how do they do it? Are they efficient? How much do they cost? Are they real bargains? Do they give you "more for less"?

These are questions to which every seeker of real value should demand definite answers.

J-60558

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

there's only one modern method of PROTECTING ELECTRICAL EQUIPMENT . . .

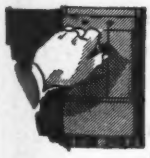
THE "DE-ION" *(fuseless)* CIRCUIT BREAKER FOR 1944!

THIS BREAKER IS THE REAL BARGAIN AMONG PROTECTIVE DEVICES, IN THAT IT GIVES YOU "MORE FOR LESS".

here's how...

1. More positive "plus" protection . . . the same protection that safeguards vital equipment on our modern battleships when failure may mean defeat.

2. More output per machine . . . does not interrupt production on harmless momentary overloads; thus preventing many work stoppages or delays.

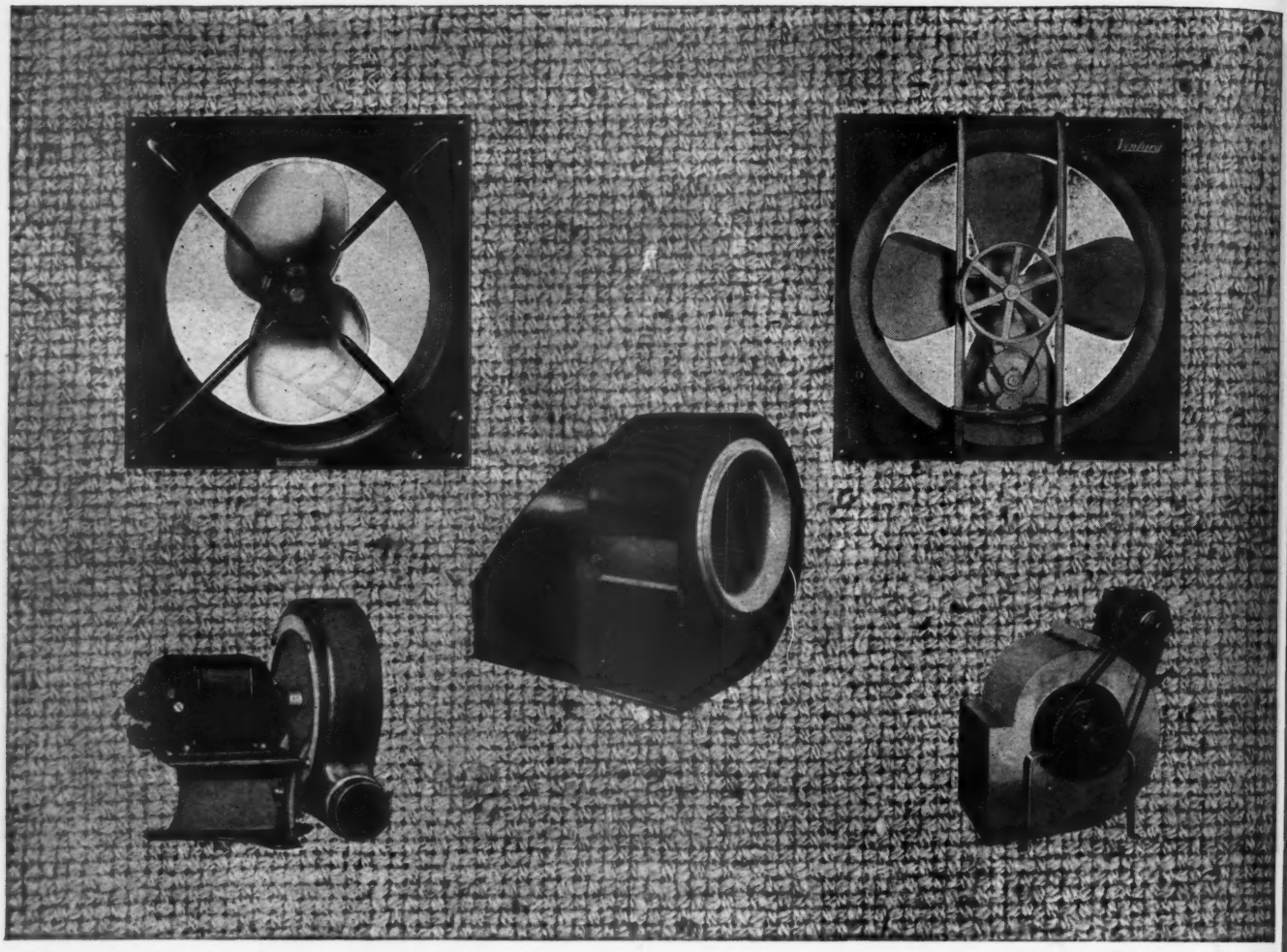


3. More safety... working parts are completely enclosed and sealed. These breakers are the safest protective devices ever built. They are absolutely tamperproof (cannot be bridged or blocked by pennies, nails or other foreign articles).

4. More productive machine-hours... assures faster resumption of interrupted service after causes of overloads or short circuits are removed. There is nothing to replace or repair—to restore service, simply throw the handle. This feature alone saves American industry more than one million man-hours yearly.

5. Less cost... the lifetime cost of the "De-ion" (fuseless) Circuit Breaker of 1944 is less than that of any other protective device. Ask your Westinghouse representative for facts and figures. Westinghouse Electric & Manufacturing Co., Dept. 7-N, East Pittsburgh, Pa.

"DE-ION" *(fuseless)* CIRCUIT BREAKERS



Do Ventilating Contractors Perform a *VITAL WARTIME SERVICE?*

"For the want of a nail, the shoe was lost." Never before has the wisdom of this saying been so conclusively proved — By Industry? Sure. Industry has performed miracles. But we specifically refer to the tens of thousands of Ventilating Contractors and Dealers in America—those who used to sell and install ventilating fans and blowers for stores, apartments, public buildings, schools and homes.

Today, their service is a vital war task. A ventilating fan to remove dangerous fumes from a war plant . . . a pressure blower to speed the supply of badly needed drugs . . . cooling for a petroleum plant . . . and thousands of other air-handling jobs in industry.

Truly, these contractors have furnished the nail that saved the shoe. And when Victory is won, their knowledge of the ventilating and allied businesses, their skill and experience, will be reflected in better facilities and improved service in furnishing American Blower Ventilating Equipment and other products to a peaceful America.

After Victory, American Blower and its dealers and distributors will again be ready to supply good ventilation to everyone. Good ventilation is good business.

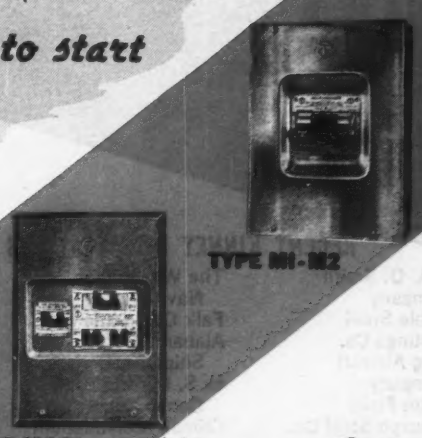
ARMY E NAVY
For Excellence in Production

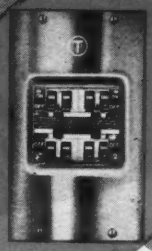
AMERICAN BLOWER

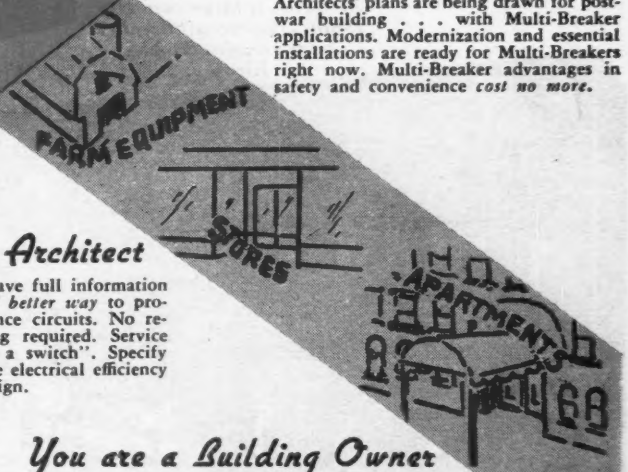
AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

SOON EVERYONE WILL "go" MULTI-BREAKER"

..and the time for **YOU** *to start is right* **NOW**!







You are a Wholesaler

. . . then be sure that your salesmen are telling the Trumbull Multi-Breaker story to contractors . . . pointing out the opportunities that will come with post-war building . . . not forgetting the many equally good opportunities that exist TODAY in replacement and essential installations.

You are a Contractor

. . . then sell Trumbull Multi-Breaker automatic overload and short circuit protection, *with nothing to renew or replace.* Architects' plans are being drawn for post-war building . . . with Multi-Breaker applications. Modernization and essential installations are ready for Multi-Breakers right now. Multi-Breaker advantages in safety and convenience *cost no more.*

You are an Architect

. . . then be sure you have full information concerning this *safe and better way* to protect lighting and appliance circuits. No replacements — no servicing required. Service restored at the "flip of a switch". Specify them — they will improve electrical efficiency in the buildings you design.

You are a Builder

. . . then consider Trumbull Multi-Breakers as one of the sales features of your future construction . . . especially since they do not add to the cost of the electrical installation.

Write for your copy of Trumbullaid Circular No. 323.

You are a Building Owner

. . . then consider the savings in maintenance and service with Trumbull Multi-Breakers. No more emergency calls to replace fuses, no danger of replacing fuses with others of wrong capacity. With NOTHING to renew or replace–even a child can restore service.

ELECTRICAL CONTROL APPARATUS

Enclosed Switches & Circuit Breakers
Motor Control

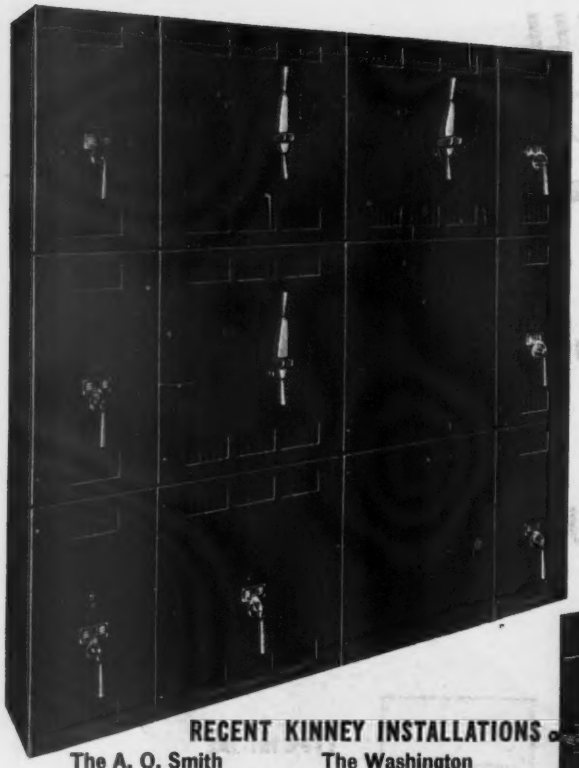
TRUMBULL (T) **MULTI-BREAKER LOAD CENTERS**

Control Centers
Panelboards Switchboards
Busways Distribution Systems
Service Equipment

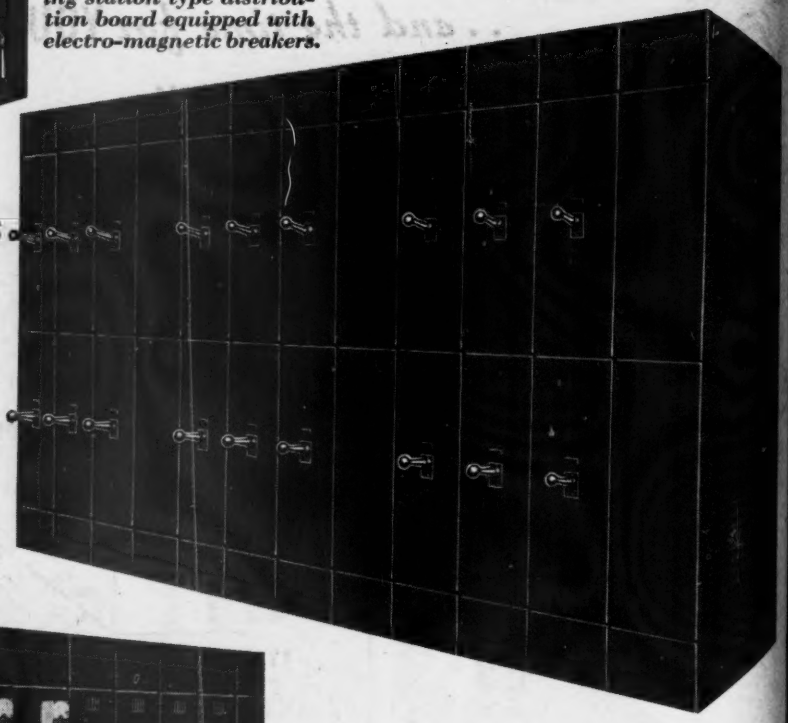
THE TRUMBULL ELECTRIC MANUFACTURING COMPANY • PLAINVILLE, CONN. • A GENERAL ELECTRIC ORGANIZATION

OTHER FACTORIES AT NORWOOD (CINN.) O. — SEATTLE — SAN FRANCISCO — LOS ANGELES

ENGINEERED FOR DEPENDABILITY



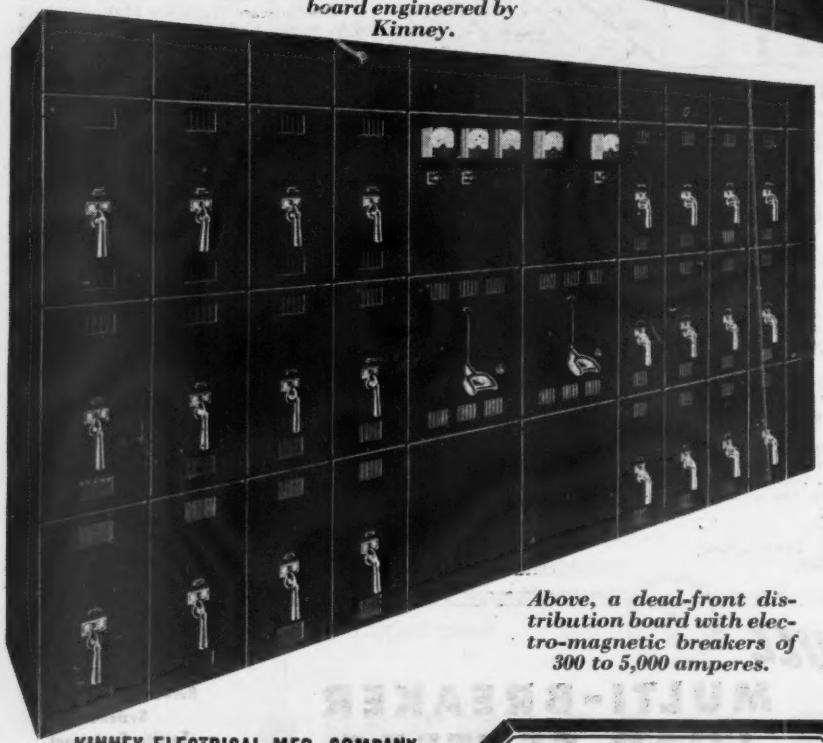
At left, a typical generating station type distribution board equipped with electro-magnetic breakers.



RECENT KINNEY INSTALLATIONS

The A. O. Smith Company	The Washington Navy Yard
Crucible Steel Castings Co.	Falk Corporation
Boeing Aircraft Company	Alabama DD. & Shipbldg. Co.
Hickam Field	U. S. Maritime Commission Vessels
Pittsburgh Steel Co.	Climax Molybdenum Company
Albrook Field	National Radio Corp.
Norfolk Navy Yard	Richardson Company
Kingsbury Ordnance Plant	U. S. War Dept.

At right, a large capacity Deion type circuit breaker board engineered by Kinney.



Above, a dead-front distribution board with electro-magnetic breakers of 300 to 5,000 amperes.

Your switchboard's trouble-free operation over the years depends primarily on the engineering skill and experience of its builder.

That's why Kinney Switchboards have been selected for many of the nation's leading industrial plants, Army and Navy facilities and vessels of the U. S. Maritime Commission. They are the product of an organization of switchboard specialists . . . an organization with a reputation for sound engineering and wide experience in this exacting field.

Bring your control and distribution problems to "switchboard headquarters." Let Kinney engineering and production skill protect your switchboard investment.

KINNEY ELECTRICAL MFG. COMPANY

2900 CARROLL AVENUE, CHICAGO 12, ILLINOIS

SWITCHBOARD **KINNEY** SPECIALISTS

Remember the old copy book axiom, "You can do a better job if you have the right tools"? Well, your machinery can do a better job, too, if properly equipped . . . properly equipped with the right motor . . . one that meets all the requirements of the job . . . "right on the nose".

For example look at the Master motor drive on the right below. By incorporating a motor, an electric brake, a mechanical variable speed unit, and a gear reduction . . . all designed and built into one compact integral power drive . . . it provides variable speed, at exactly the right range, and in addition can be quickly stopped and started again for increased production.

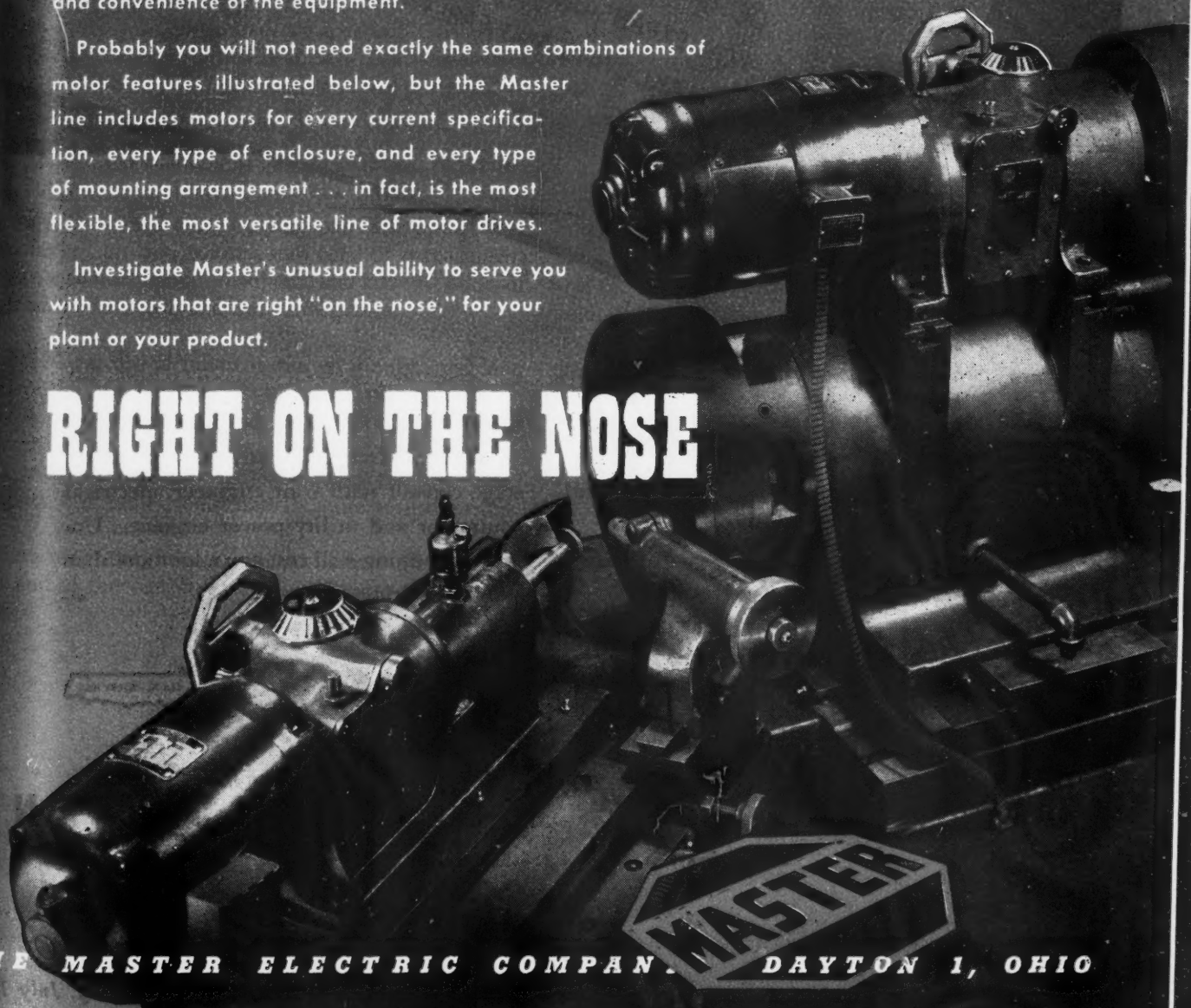
The other unit consists of a motor and a mechanical variable speed drive which are easily combined into an integral unit that gives smooth stepless variable speeds from 600 to 5000 RPM.

Each motor drive mounts neatly on the machine, saves space, saves money and greatly improves the output, safety, appearance and convenience of the equipment.

Probably you will not need exactly the same combinations of motor features illustrated below, but the Master line includes motors for every current specification, every type of enclosure, and every type of mounting arrangement . . . in fact, is the most flexible, the most versatile line of motor drives.

Investigate Master's unusual ability to serve you with motors that are right "on the nose," for your plant or your product.

RIGHT ON THE NOSE



THE MASTER ELECTRIC COMPANY DAYTON 1, OHIO

CLIMAX OF INVASION

When men and machines hit the beaches of France on D-day, the hardened edge of the assault was backed by lines of supply extending thousands of miles in distance and years in time. The best trained and best equipped fighting force of all time performed the most difficult of all military operations, an attack from the sea on a well defended coast line. And the blow started way back in ordinary operations impossible to distinguish from peacetime activity.

A helper taped a joint which connected a motor, which drove a lathe, that turned a casing, that carried the charge, that hurled the shell, that broke the back of a key defense position. The line of actual participation in the assult, sharp and distinct at the beachhead, broadens rapidly over millions of men and machines and organizations at the base. Back in distance and time the individual contribution becomes less and less distinct. But it is there. And every fighting man hitting the beach was backed up by a colossal sum total of management hours, machinery hours, manhours and kilowatt hours of intensive effort, skill and industrial genius.

For the electrical industry, the invasion started long before the broad outlines of the military strategy were drawn. It started in the wiring of barracks and industrial plants, in the vast network of electrical circuits which had to be installed and energized before the first plane, ship, tank or bullet could start its journey to the front.

Invasion is the climax of a great military plan. It isn't the end of the war. It is just the beginning of a great new phase of the inevitable march to victory. There is still a huge job to do at home as well as on the fighting fronts before peace will come.

But the working and thinking of the men of the electrical industry today is going to have a pertinent and direct effect on the economy of this country when the war finally comes to an end. The plant changeover job to handle a design change in production can point the way to reconversion. The records and routines set up for motor and control maintenance can provide up-to-date and ready reference for peacetime power facilities. Electrical methods of war production can suggest practical ideas for the peacetime assembly line. And though our work is still geared to the war tempo it is setting the pattern of a peacetime industry.

Speed will be the essence of reconversion. And just as in conversion to war the electrical work must come first. The planning must be done now. Existing facilities and current jobs should be considered in the light of potential reconversion requirements. And again, though the climax of reconversion may still be far off, the foundations will be substantial and sound and the future secure and confident.

Wm. T. Stuart

TO HELP SOLVE A 3 DIMENSIONAL PROBLEM

1 PRODUCTION FOR WAR
2 PREPAREDNESS FOR CHANGE
3 PLANNING FOR THE FUTURE

WE OFFER *Threefold* SERVICE

GraybaR *via* GraybaR

Today, the electrical contractor faces three problems, which *must be considered and treated as one.*

The first of these is to help industry maintain production. Electrical contractors are doing their part, with maintenance contracts and fast emergency service on replacements, to keep materials needed for war flowing fast. In this work, the GRAYBAR Man helps you do a better job through material selection aid and speeding supplies to your jobs.

At the same time, industry is preparing for quick, efficient change-overs as war needs alter, slow up, or end. In this second phase, the electrical contractors' job will be to modify or replace power distribution systems, install new lighting, modernize communication systems. Here, too, your GRAYBAR Man is prepared to help you with specialized information and fast procurement service.

Third, business is planning for tomorrow — today! Long-deferred construction of commercial buildings is already on thousands of drawing boards. Department stores plan entirely new lighting systems. Housing projects are being discussed. Each of these plans for tomorrow can be a profitable job for some electrical contractor. GRAYBAR, also, is planning for the future. Though busy with war, your GRAYBAR Man has kept fully informed about the materials to come, and the best methods for using them.

There is a local GRAYBAR Representative ready to make your three-dimensional problems his personal responsibility.

3544

IENSIONAL SE
GTH of EXPERIE
BREADTH of LIN
TH of KNOWLE

GraybaR

MOBILIZATION POINTS IN OVER 80 CITIES

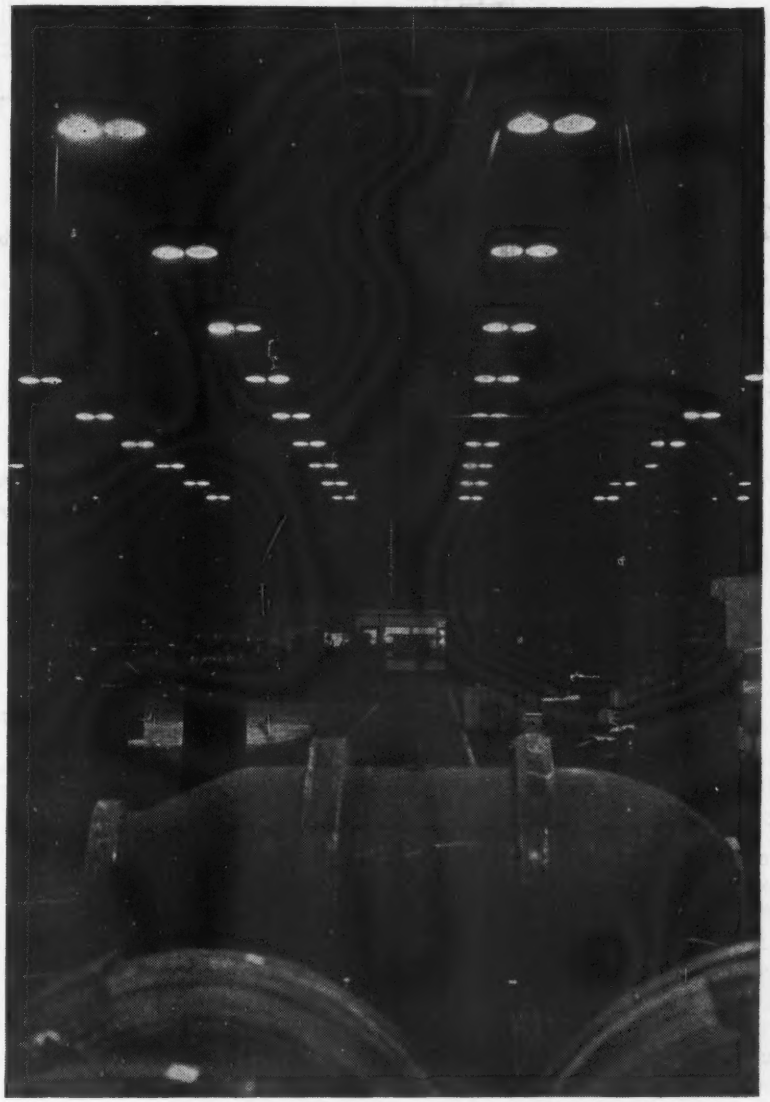
EXECUTIVE OFFICES: GRAYBAR BUILDING, NEW YORK 17, N. Y.

GraybaR 75 YEARS OF *Electrical Distribution*

Lighting Distribution Design at 2300 Volts

High voltage feeders carried overhead in fiberduct with open wiring design used for branch circuits. Staggered high bay mercury and incandescent units provide high quality, high level illumination.

By R. E. Miller



***MERCURY AND INCANDESCENT** units mounted side-by-side at a height of 26 feet to provide required illumination in the finishing department. Forge shop beyond wall contributes materially to dusty atmosphere. Fixtures are protected by dust-tight lenses.*

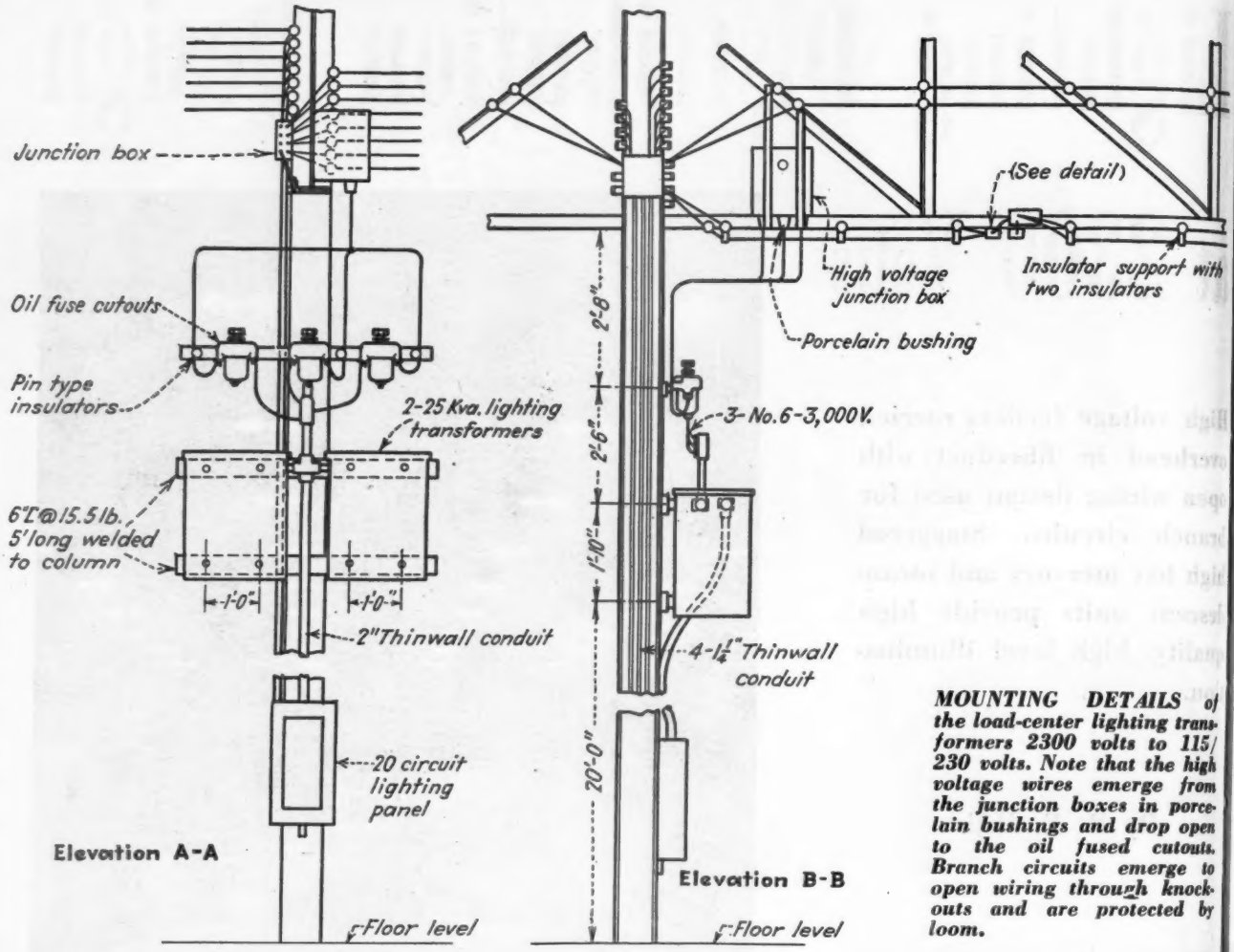
INDUSTRIAL plant distribution at high voltages for both power and light is proving to be an important solution to electrical distribution problems. Copper requirements are considerably reduced; voltage regulation is much better; a greater simplicity in both design and construction is afforded; and greater flexibility is provided in operation and under conditions of increasing load.

Plant distribution at Harrisburg Steel Corporation's new plant in Harrisburg, Pa., is made at 2300 volts in fiberduct, part of which is suspended overhead and part carried underground in concrete envelope (*Electrical Contracting*, May, 1944).

The fiberduct, which is not as rigid as steel and cannot be coupled as tightly, proved to be a little tricky in installation. Even though it is suspended every four feet by steel strap hangers from the purlins, it still has a few noticeable horizontal and vertical sways. However, it has proven very satisfactory and, in view of the critical material situation at the time of construction, showed a very prudent decision on the part of the designer, C. H. Mincho, now general electrical superintendent for the Harrisburg Steel Corporation.

The metal-clad, draw out type, 2300 volt distribution switchgear is sectionalized at the center. The switchgear bus is fed at both ends from two 5000 kva. (air-blast rating) power transformers, three phase 13.8/2.3 kv. The two lighting feeders, which supply the entire plant and office load, are placed on either side of the sectionalizing breaker to provide as much insurance as possible against total outage of lights in an emergency. One feeder supplies the east longitudinal side of the plant while the other supplies the west side. Oil circuit breakers are rated 600 amps with 100,000 kva. interrupting capacity.

Each lighting feeder leaves the board with three No. 4/0 cables in three-inch fiberduct. Hangers made from ¼ by 1-inch black steel strap supports the duct on four-foot centers from the purlins. As the feeders approach the end of their respective runs, they taper to two No. 2 in two-inch duct. Wherever lighting transformers are located the fiber duct passes through specially



***MOUNTING DETAILS** of the load-center lighting transformers 2300 volts to 115/230 volts. Note that the high voltage wires emerge from the junction boxes in porcelain bushings and drop open to the oil fused cutouts. Branch circuits emerge to open wiring through knockouts and are protected by loom.*

constructed high voltage junction boxes.

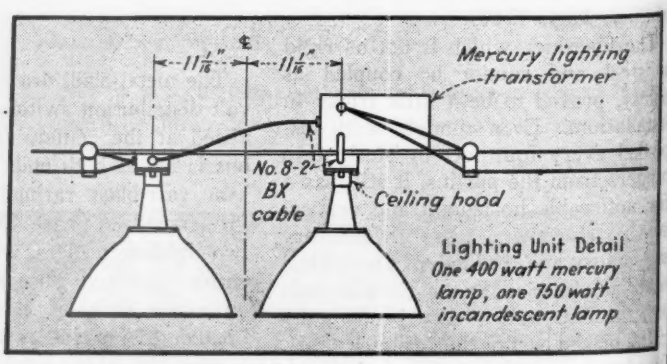
Three No. 6 taps (3000 volt insulation) are taken off at the junction box, pass out through porcelain bushings and drop open to the oil fuse cutouts mounted on the building column above the transformers. The cutouts and pin type insulators are bolted to a length of three-inch channel iron which is in turn welded to the column. Leads from the fused cutouts enter conduit for the short run through the transformer case to the primary terminal board.

The lighting transformers are hung 20 feet above the floor either singly or in twos, depending upon the amount of lighting load to be handled. Ten, 15 and 25 kva. units, 2300 volts to 115/230 volts, are bolted onto two lengths of six-inch channel iron which is both bolted and welded to the building column.

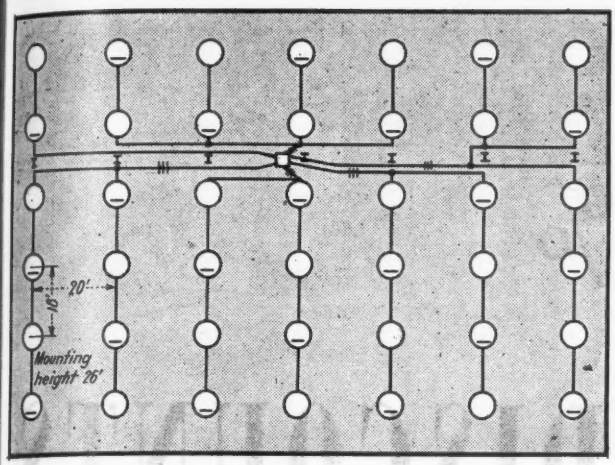
The secondary lighting mains (3—No. 2/0) drop to the lighting panel below in two-inch thin-wall conduit. The panels are either 12, 16 or 20 circuit non-fusible breaker type units depending upon the area served. Generally, the bottoms of the panels are mounted four feet above the floor and, where possible, on the same column as the transformer.

The branch circuits (all No. 8) are taken back up the building column in four 1¼-inch thin-wall conduits to a 12- by 12- by 4-inch junction box for distribution. Branch circuits are protected leaving the junction box by loom

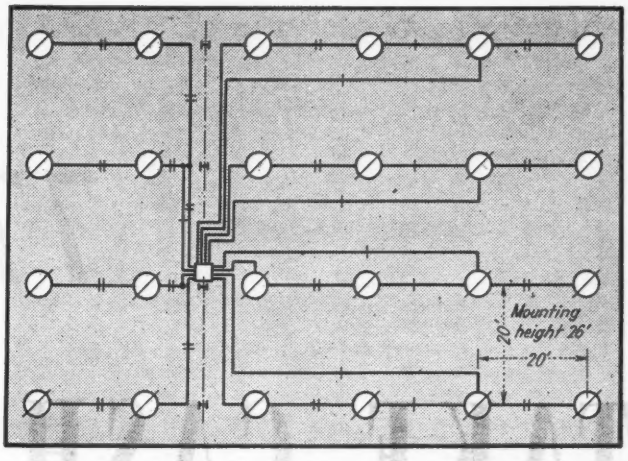
***LIGHTING FIXTURES** in the finishing department are mounted side-by-side and are controlled by the same circuit. Note transformer and open wiring on steel work.*



***LIGHTING UNIT** detail showing the mounting of mercury transformer, fixtures and wiring. Armored cable runs from transformer to connection boxes.*



***TYPICAL LAYOUT** of a section in the forge shop where single units of mercury and incandescent are staggered on 18 by 20 foot centers.*



***TYPICAL LAYOUT** of section in the finishing department where double units of mercury and incandescent provide high quality illumination.*

through the knockouts. The circuits then continue open or porcelain knobs bolted to insulator clamps.

Fixtures

Standard dome reflector units with dust-tight lens attachments are usual throughout the plant areas.

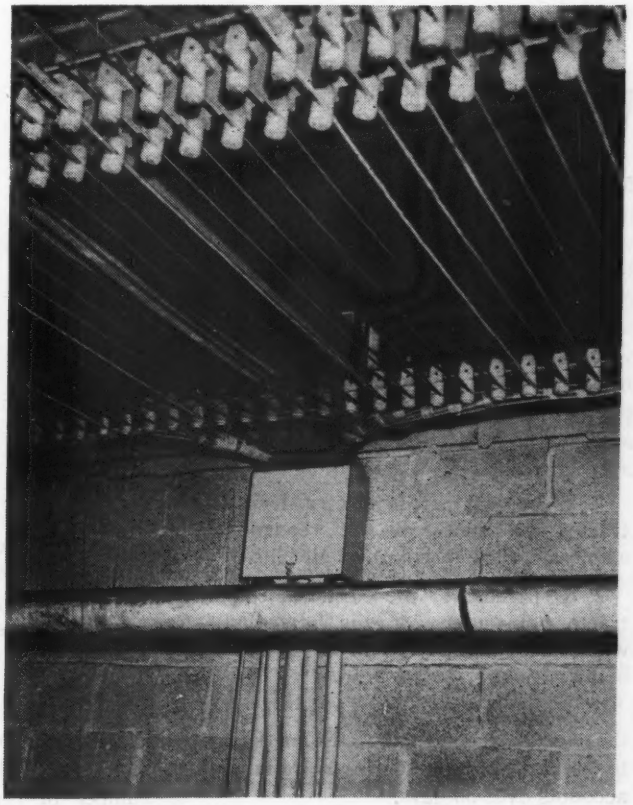
In the finishing department where high levels of illumination are required, double units are mounted 26 feet above the floor on twenty by twenty foot centers. The units which are mounted side by side, as in the accompanying photographs and diagrams, are high bay 400 watt mercury and 750 watt incandescent. The same circuit serves both units, entering the mercury unit transformer case and passing on to the next unit to be controlled by the same breaker. Taps are taken off within the case for the transformer primary, and for the incandescent unit. Two lengths of armored cable (two-No. 8) run from the transformer case to the two fixture connection boxes.

The forge shop, which adjoins the finishing department is equipped with a staggered mercury-incandescent installation of single units. The fixtures are the same as in the finishing department with standard dome and glass dust-tight lenses. High-bay 400-watt mercury units and 500-watt incandescent units alternate on 18 by 20 foot centers and are mounted at a 26 foot height.

The machine shop area is furnished with the highest illumination levels of all. Here again the reflector units are of the same type. They are hung singly, and 400-watt mercury and 500 incandescent units are mounted alternately at a height of 21 feet on 10 by 12 foot centers. One of the accompanying photographs shows the distribution of branch circuits from a junction box. The open wiring can be seen fanning out across the ceiling on porcelain insulators clamped to the building structural steel.

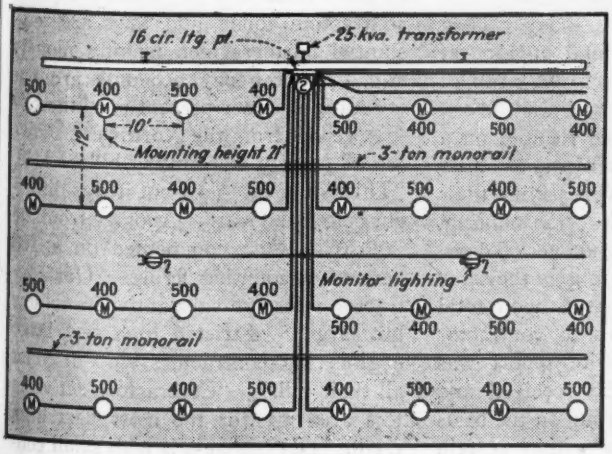
RIGHT

***JUNCTION BOX** at ceiling of machine shop. The open-wired circuits fan out over the area to lighting units. Note loom covers insulation of the wires to the first insulator.*



BELOW

***TYPICAL LAYOUT** of a section of machine shop showing transformer, panel and junction distribution box. Fixtures alternate on 10 by 12 foot centers 21 feet high.*



77%

TAKE CASH DISCOUNTS

Credit position of electrical contractors as reported in a survey of 153 electrical wholesaling firms shows exceptional financial strength and sound business practices.

By W. T. Stuart

WHAT changes has wartime business wrought in the credit standing of electrical contractors? Materials scarcity, priorities, fewer marginal operators, and a heavy volume of war business would logically bring better pay and more orderly credit practices. But what are the facts? *Electrical Contracting* asked wholesalers over the country to tell us in simple terms how contractors are paying their bills as the most direct approach to an accurate picture. Here are the results—

1. 77 percent of the electrical contractor customers of the reporting wholesalers are discounting all bills.

2. 89 percent of the electrical contractor customers of the reporting wholesalers are paying in 30 days or better.

3. An average of only 11 percent of the electrical contractor customers of the reporting wholesalers are running accounts over 30 days.

4. In dollar volume of sales the figures show even better pay, 82 percent is discounted, and 92 percent paid within 30 days.

Survey Made

Drawn from a nationwide survey conducted within the last two months by our editorial staff these figures represent credit conditions today. They are compiled from a total of 153 reports from wholesalers in 98 cities of the East, South, Midwest and West. Wholesalers were asked to note on a questionnaire what percent of their contractor customers were paying their bills in four categories; discounting, 30 days, 30 to 60 days and over 60 days. They were then asked to give the same type of information based upon total dollar volume of sales to contractor customers. A composite report was prepared from the 153 received and another analysis drawn up on the basis of number of reports within certain class intervals. The resulting figures are given in the tables on the following pages.

Many of the returns were accompanied by frank and significant comments. Some of the wholesalers compared their credit experience with electrical contractors now and before the war. Summing up the general attitude of these remarks; (1) there are fewer contractors today and they are substantial business men making money, and (2) slow pay accounts are not encouraged under present conditions.

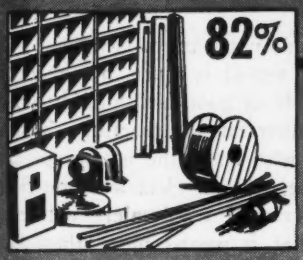
A report from the Northwest, showing 98 percent discounting bills, added, "This is the case now but it was different before the war". Another from the industrial East commented on a 100 percent discounting figure—"Our contractor sales are substantial in volume but largely restricted to a few large engineering contractors who discount all their bills". "Contractors active in this area are for the most part high credit. Our business is with small con-

77% OF ALL CONTRACTORS DISCOUNT BILLS

68 wholesalers report	85-100%
42 wholesalers report	70-84%
27 wholesalers report	50-69%
16 wholesalers report	less than 50%

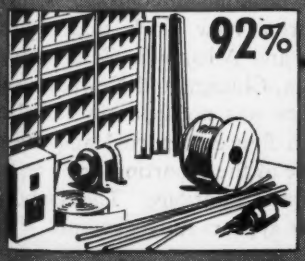
89% OF ALL CONTRACTORS PAY IN 30 DAYS OR BETTER

68 wholesalers report	95-100%
43 wholesalers report	85-94%
27 wholesalers report	70-84%
12 wholesalers report	50-69%
3 wholesalers report	less than 50%



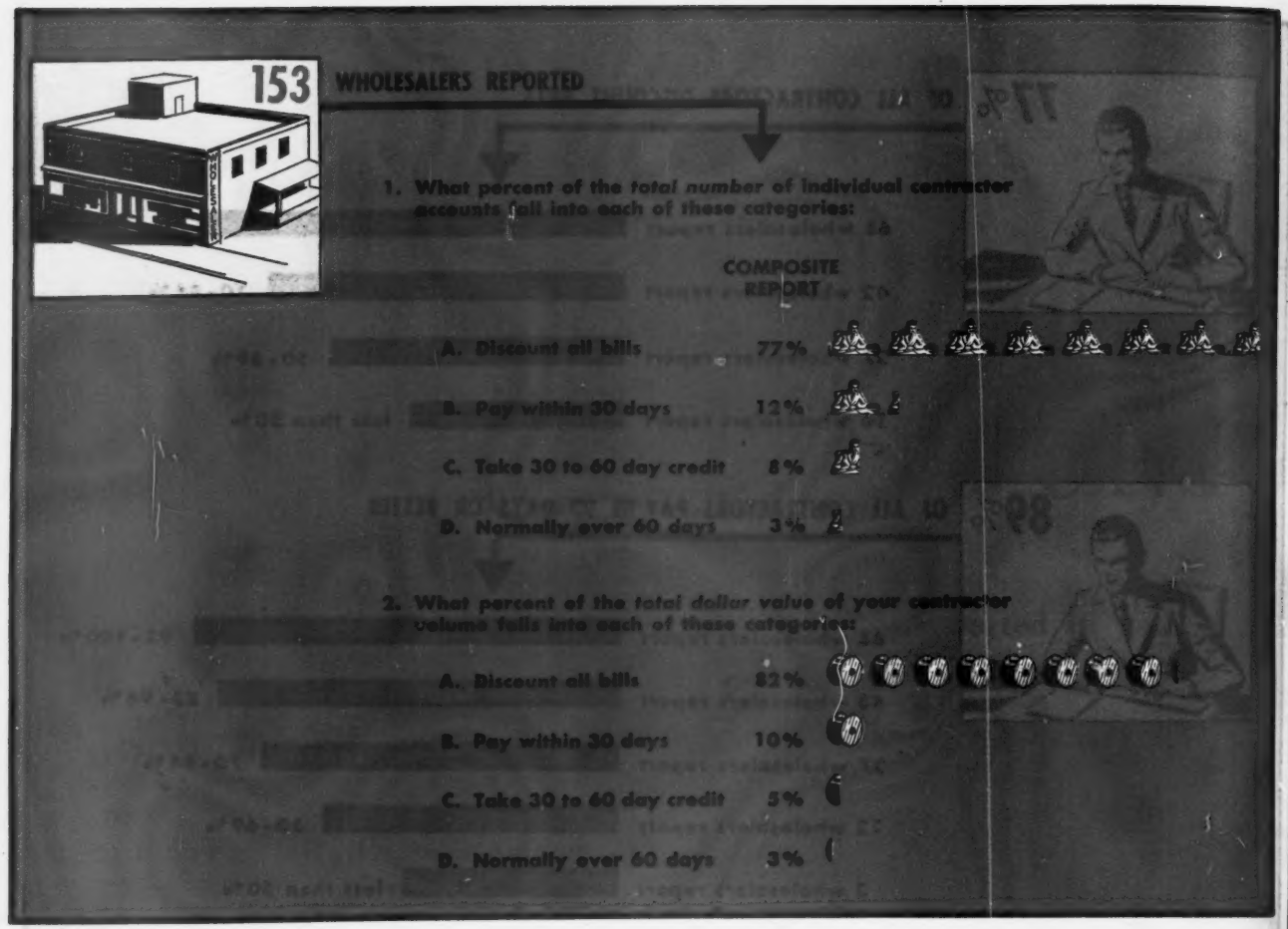
82% OF DOLLAR VALUE OF CONTRACTOR BUSINESS IS DISCOUNTED

83 wholesalers report	85-100%
41 wholesalers report	70-84%
19 wholesalers report	50-69%
10 wholesalers report	less than 50%



92% OF DOLLAR VALUE OF CONTRACTOR BUSINESS IS PAID IN 30 DAYS OR BETTER

84 wholesalers report	95-100%
40 wholesalers report	85-94%
23 wholesalers report	70-84%
4 wholesalers report	50-69%
2 wholesalers report	less than 50%



tractors who are universally prompt", says a Middlewest wholesaler in reporting 98 percent pay within 30 days.

A more hardboiled attitude accounts for some of the high percentages of discounted bills reported. A Southern wholesaler reports, — "Very little trouble with contractor accounts—we will not take questionable accounts—nor carry over 30 days—we carry 75 percent of the contractor business in our city—our credit losses for 1940 on almost $2,000,000 business was 5 one thousandths of one percent and none in 1943". From New England a wholesaler reports,—"We have made it a rule for the duration to accept no accounts which do not discount on the 10th prox. and all current sales are on that basis". Another says—"Most discount, the rest pay in thirty days—they have to—or else!" And from a Southeastern wholesaler comes a word of hope for the future,—"We can afford to be hardboiled today and hope to be able to pursue the same policy when we get back to normal business. Any contractors doing business today should be able to discount!"

Good business is credited too with improving financial practices. A North Central wholesaler says,—"Contractors generally are now in excellent condition, with more work than they can handle and no destructive competition. Our receivables are turning over in 29 days on 30 day terms." And another says,—"I have been in the electrical business for 45 years and have never seen the contractor make the money most of them are today."

Practice to Continue

It is enough to let the record stand for itself. But it is also safe to draw therefrom a significant corollary or so.

(1) While the condition reported is for war business, the substantial credit practices will tend to continue into the postwar era. Both wholesalers and contractors who have experienced the important business advantages of good pay are reluctant to accept any other basis of doing business.

(2) Marginal operators who have left the industry to work in other fields will find on their return a more strict and realistic credit policy waiting at the wholesale counter.

(3) Strict wholesaler credit terms are entirely compatible with good contractor business volume and insures against slow pay costs that good customers do not want to pay for.

This report is more, however, than just a bill of good health credit-wise in the electrical contracting business. Those who know the history of credit practices among electrical contractors and electrical wholesalers will recognize that it means more than "good business makes good collections". The returns are not from a selected group of large wholesalers with rigid credit practices but is a large sample from all kinds and sizes of wholesaling firms serving all kinds of contractors. They come from New York, and Oshkosh, Seattle and Allentown, Zanesville and Houston, Chicago and Newport News, yet there was no apparent correlation between figures reported and the size or scope of the reporting firms on their geographic locations. The sound pay practice appears to be general.

Bills Being Discounted

The great majority of contractors today are discounting their bills. They are financially strong and building a new credit record that parallels progress of the industry in technology and management skill. And all that is a substantial foundation for greater responsibilities after the war.

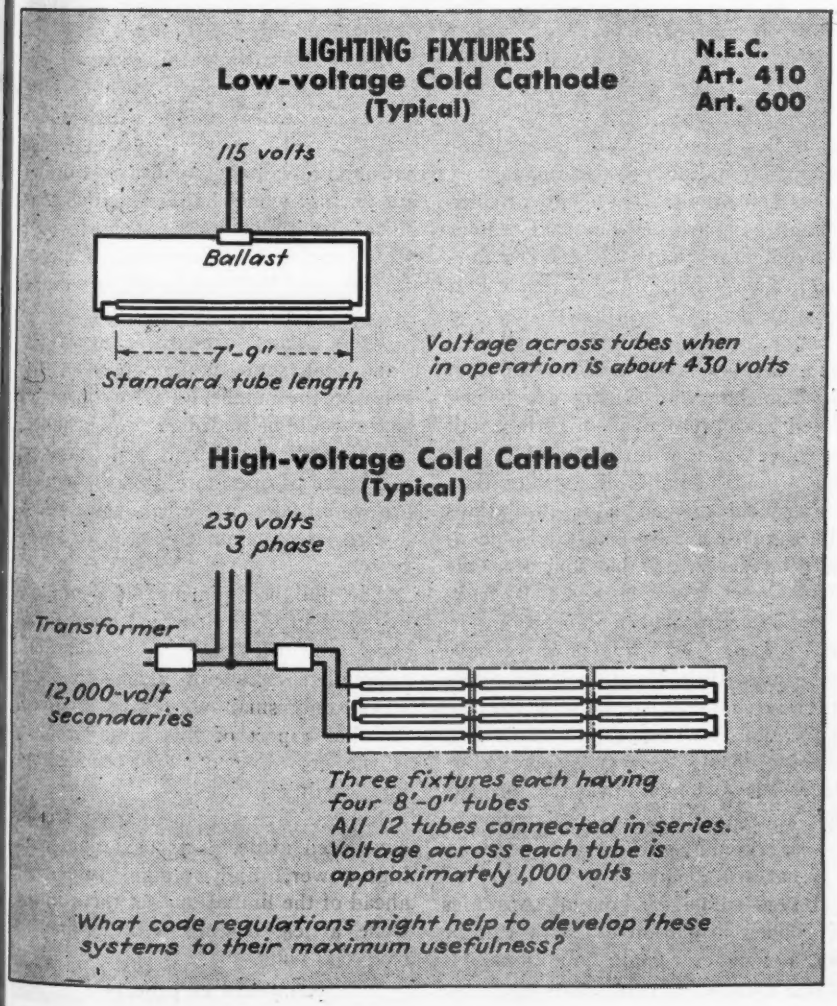
OUR NEXT
National Electrical Code

The 1945 Code is in the making. Committees are at work on recommendations and amendments. Here are the problems and prospects facing our Code makers today.

THE writing of our next Code is to take place in a war atmosphere within sight of the first phases of victory, a situation in which unusually good judgment will be needed if the new rules are to aid to the fullest extent in the period of reconstruction.

There is a widespread notion that we are becoming richer daily because people are buying heavily of war bonds, while really we are engaged in expending our wealth to serve the forces of destruction.

Reconstruction will call for still better use of materials and methods, but it will not usher in an era of extravagant buying. Our ever-growing industry will continue its expansion, and our Code makers should so plan new wiring regulations that the needs of expansion may be met by new concepts and more efficient designs of power distribution.



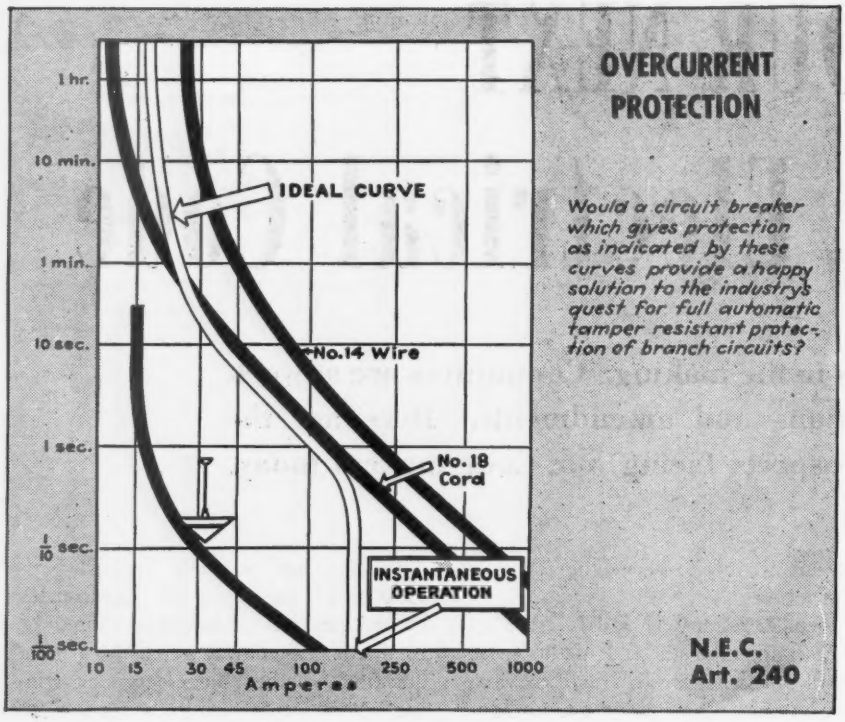
War-wiring methods will be reviewed in the light of experiences gained and the advantages should be retained. Of course, it will be a moot question whether the emergency wiring schemes approved in the Code Supplement represent advances or retrogressions. There will be a vast fund of information available on which the Electrical Committee can draw in arriving at conclusions.

Article 670 of the Supplement on Machine Tools is an example of one wartime wiring regulation which will, undoubtedly, be retained and modified to match field experience with this new subject of the Code. Mention of Article 670, which treats only of metal-working machinery, brings with it the question of the broadening of these regulations to include other kinds of machines such as wood-working equipment.

The Interim Amendments of the Supplement advanced some practices as, for instance, the changed rule on the grounding of range frames, by which the use of the neutral for grounding the range was approved, provided the range was not in contact with other grounded structures.

On the other end of the scale were amendments having to do with temporary insulating materials, which have already served their usefulness in view of the availability now of synthetic rubber insulations. Interim Amendment No. 69, which approved Type EI insulations (paper wrap, etc.) on ungrounded conductors, has already been withdrawn after having been in effect for only 20 months.

As to the form of our next Code, it appears desirable for one thing that the various diversity factors be correlated as much as practicable. There is an 80 percent derating factor for con-



tinuous lighting loads, a 25 percent overcurrent allowance for motor loads, and an assumed rating of 7 kw. for a 12 kw. range, or one may use an 80 percent demand. While no one of these values is being questioned, it is always desirable to have as much uniformity of style throughout the Code as is possible.

There have been problems brought about by continuous operation of appliances and apparatus which it is hoped can be solved without affecting wiring capacities required to serve ordinary loads. For instance, switches and conductors serving capacitors must necessarily be based on continuous full-load operation. Conversely, an example of a low-duty cycle load might be a welder.

Welding loads present problems of voltage regulation which have been met by concentric conductors and other low-impedance wiring arrangements. These loads, however, have high diversity factors, and we may suppose that the Technical Sub-Committee studying these applications will bring in recommendations which will allow for smaller but still ample-sized conductors.

The electrical industry must take care that while the usage of electricity doubles each decade, the proportionate number of electrical fires and accidents will continue to go down. Still better appliances and protection are wanted. Grounding of equipment frames, naturally, comes up in any safety discussion, but is this the best approach? Should more reliance be placed on higher standards of insulation and greater clearances between conducting parts and equipment frames? How are the needs of protection for small motors going to be met? Will in-built protection provide the answer?

Wiring adequacy provides a measure of safety. Take, for example, those Code regulations calling for so many receptacles based on wall length, and without limitation on the number of outlets per circuit. These sort of rules seem to have worked out well despite local difficulties that have been encountered in the rewiring of large residences, like on a farm. Nevertheless, it is the industry's job to promote and sell adequate wiring as such. The extent to which adequacy of wiring can be required as a prerequisite to safety, not for convenience, will remain, of course, to be a fundamental Code consideration.

The field of conductor insulations will, supposedly, be recast. Some of the 19 types which blossomed in the 1940 Code never bore much fruit. Then, there was only one class of synthetic, Type SN, while now we have the Bunas, Butyls and so forth, all of different characteristics and of varying applications for best results. Polyvinal chloride makes a very good jacket, Butyl has excellent dielectric properties, and so we may expect synthetics to be covered by various classifications.

What will be done about the 1937 and 1940 values for current capacities of rubber insulations? Both can be justified under certain conditions. It is still a matter of continuous operation versus diversity. The industry expects an answer to this problem.

New conductor types will probably be included too, as approved, for example, in the recently issued amendment to machine tool wiring wherein copper-clad steel conductors are recognized.

It would be helpful if somehow the variables affecting conductor capacities could be brought together into fewer factors. The differences on account of grade of insulation, installation open or enclosed, number of wires in a raceway, and room temperature were bothersome. It is hoped that these tables can be simplified without sacrifice of accuracy for expediency.

The writing of the new Code may make it possible to get away from that anomalous 1940 installation wherein conductors rated for continuous load were connected to fusible switches incapable of carrying their full rating continuously.

The reconstruction period is going to be an opportunity for rewiring and for new work, and in this connection thin-wall insulations will provide a splendid means of modernizing property. Has sufficient experience been accumulated with some thin-wall insulations to safely remove their limitation to rewiring only?

In the realm of speculation, a new form of raceway might even be proposed like flexible tubing, which would come in coils. Such a system would have the advantages of draw-in draw-out wiring, would be like flexible conduit, but with a smooth interior, would provide mechanical protection for conductors, and its squeeze fittings would save the work of threading.

There seems to be a feeling in the trade that some modification of the rules on the number of wires in outlet boxes would be in order. For instance, in the ordinary 2-inch wall case an allowance of one more or six conductors would take care of a 2-wire and a 3-wire cable connected to a 3-way switch.

The pull box dimensions contained in the 1940 Code provided good guidance toward proper installations, although a change would be in order where only small wires are involved. Another aspect of this same problem is the crowding of large conductors into conduit fittings.

In protective equipment, great strides have been made, as for example with high-power, high-voltage fuses far ahead of the limitations set forth in the Code article dealing with equipment over 600 volts.

[Continued on page 141]

What are some of the problems which article committees will tackle in preparing the '45 Code? These diagrams graphically illustrate questions now before the Code makers.

Conductor Ratings

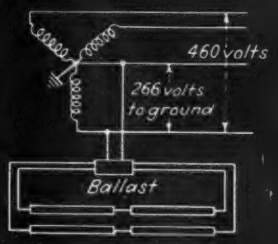
1937	1940	War Supplement	1945
No. 6 Type R 50 amp.	45 amp.	50 amp. Non-Continuous Operation 45 amp. Continuous Operation	?

Conductor Insulations

1937 Types	1940 Types	1945
Rubber	R – Code	?
	RW – Moisture Resistance	
	RU – Unmilled	
	RP – Performance	
	RPT – Performance Thin-wall	
	RH – Heat Resistant	
	RHT – Heat Resistant Thin-wall	
Slow-Burning	SB	
Slow-Burning Weatherproof	SBW	
Weatherproof	WP	
Varnished Cambric	V	
	AVB – Asbestos-Varnished Cambric	
	AVA – " " "	
	AVL – " " "	
Asbestos	AI – Impregnated Asbestos	
	A – Asbestos	
	SNA – Asbestos-Synthetic	
	SN – Synthetic	
	Wartime Developments of Synthetics { Buna-N, Buna-S, etc.	

Lighting Circuits

N.E.C. Art. 210



Four 100-watt lamps

Lighting circuit over 150 volts to ground supplying a fixture having two sets of two fluorescent lamps in series

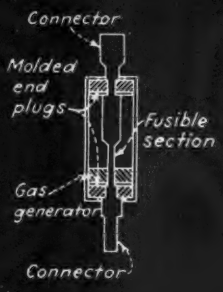
Article 210 stated that branch circuits shall not exceed 150 volts to ground. Interpretation 229 recognized branch circuits over 150 volts to ground in industrial establishments supplying fixtures more than eight feet from the floor.

What will the next code say about circuit voltages?

Conductor Protection Industrial Networks

N.E.C. Art. 240
Art. ?

When is a fuse not a fuse? When its a limiter.



A Limiter in Cross Section

A fuse is essentially an overload protective device, whereas a limiter is intended to interrupt fault current only.

Section 2403 – Conductors shall be protected in accordance with Tables 1 and 2 – Allowable Current-Carrying Capacities of Conductors in Amperes.

While fuses are rated in amperes, limiters are rated in conductor size 4/0, 350 mcm, etc.

This is an advance in the art calling for code coverage.

Continuous Operation (Typical)

N.E.C. Supplement

Conductors – 3 No. 6 type R rated 45 amperes on account of continuous operation of load.

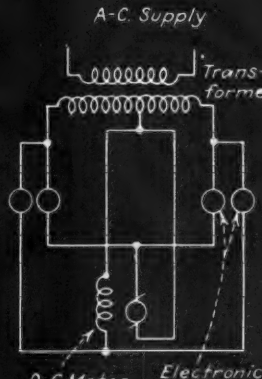
Switch, fusible – what rating should be applied to such a switch. Some fusible switches can carry only ⅔ full rated load continuously.

Load to be operated continuously. Example – Capacitor bank used for power factor correction

If same equipment is to be derated on account of continuous operation at or near full load, what about other equipment in the circuit?

Controllers Typical Electronic Unit

N.E.C. Art. 430



Elementary Diagram
Control equipment, etc. not shown

Under which classification does this sort of equipment belong?

Control system	– Art. 800
Controller	– Art. 430
Generator (of D.C.)	– Art. 445
Special Equipment	– Chap. 6

Will the increasing use of electronic controllers call for a separate place in the code?

WIRING IS

The National Adequate Wiring Bureau is setting the stage today for better wiring and greater convenience in the postwar period.

WHEN the shooting stops and the barriers of war regulations are cleared away, the home building industry will be humping to meet the demands for new homes. Pressing needs long deferred by depression and war will cut loose at a time when folks have money in the bank. And most forecasters talk about a million homes a year.

There is one great problem, however, that has the operating builder worried. Good customers with cash in their pockets want something that no builder is ready to sell them. They want *postwar* homes. And postwar homes, whether the four walls and roof are traditional Cape Cod or a modern dream of glass or plastic, are homes ready for postwar living equipped with all the comforts, conveniences and gadgets that Mr. & Mrs. America have been taught to expect and want. Many months must elapse between reconversion and postwar ranges, dishwashers, laundry equipment, radios and television are ready for the market. The home building industry, however, can get under way at once with available labor and materials. And the vital element that can give the home buyer a postwar home at once is adequate wiring.

How can we have adequate wiring now? Under wartime restrictions the plain answer is we cannot. But when, one day the home building industry gets the green light there are five forces that ought to be already set up and in action.

1. An electrical industry alive to opportunities of adequate wiring and prepared with the know-how.

2. A buying public educated to the importance of adequate wiring as the key to electrical living in the postwar home.

3. An architectural profession keenly aware of the functional advantages of adequate wiring in home designing.

4. A building industry responsive to the public demand for better living through electrical facilities and convenience; and

5. Financial institutions and appraisers prepared to weigh and recognize the effect of adequate wiring and modern electrical facilities on the total value of the property.

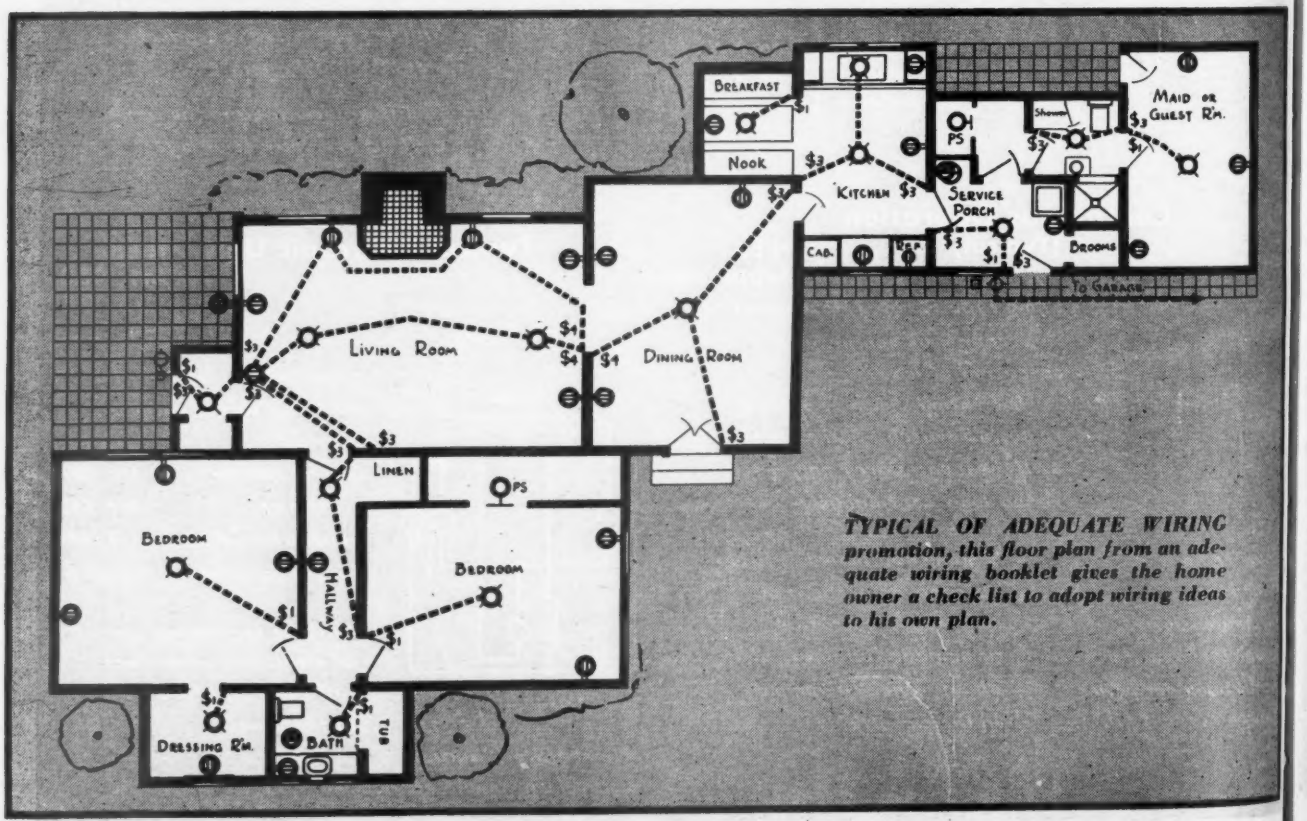
Today the National Adequate Wiring Bureau and cooperating organizations over the country are emphasizing the importance of adequate wiring in the development period of postwar home building that is now in progress.

In approaching the building fraternity, the 1944 theme, "Adequate Wiring —the key to the home of Tomorrow" is supported by a point by point development of the advantages of wiring for bridging the gap between what builders will be able to give the home buyer and what he will want in his postwar home.

1) Electrical materials will be available promptly for civilian building. Production and distribution now going into military channels can be moved without delay into home building operations as soon as regulations permit.

2) The public has been subjected to a barrage of "dream home" ideas from the probable to the almost fantastic. It has colored their thinking and stimulated new demands.

3) Reconciling home buyers' demands with what the postwar home market will afford is of vital importance. But never before has the problem reached such proportions in a



***TYPICAL OF ADEQUATE WIRING** promotion, this floor plan from an adequate wiring booklet gives the home owner a check list to adopt wiring ideas to his own plan.*

IS THE KEY

By W. T. Stuart

Symbol of the Adequate Wiring Campaign

market which everyone hopes will spark reconversion and re-employment for postwar.

4) The postwar home can only be the composite of the available "know-how" of some 14 sub-contractors and their suppliers. What the market will offer will be the sum of what they can produce for the builder.

5) Of all of the "know-how" required none is more important than that of the electrical job. The building fraternity must understand and recognize the major changes that have occurred in electrical work as a result of advancing technology.

And adequate wiring is the answer. It offers the key to all of the postwar electrical devices that home owners are expecting and will demand. It is the way that builders can assure prospective buyers that proper provisions for postwar living have been made in the plans and specifications.

Behind the answer to the builder's problem is a backlog of public education in the meaning and importance of wiring. The effect of this education will be a critical appraisal by the buyer of certain features of the wiring system which he has learned to recognize. Wartime housekeeping and the difficulty of obtaining speedy service on blown fuses and wiring troubles has initiated electrical home maintenance classes in many cities. They have been well attended and N.A.W.B.'s publication "Wartime First Aid for the Home Wiring System" has been widely distributed and read.

Instruction programs, aimed at helping the home-maker keep the wiring system in operation while electric service men are in military service, have inevitably taught people many of the elementary facts about wiring installations. They have learned that overloading blows fuses. They have learned in the process of changing fuses or restoring breakers, that each fuse or breaker has a circuit and that too few circuits mean frequent overloading. They have learned that a three wire service has greater capacity than a two wire entrance; that larger wires can carry more current; that more circuits permit the use of more appliances and that the length of circuits can affect the operation of electrical appliances.

However elementary such knowledge may seem to electrical men, it can be a vast and compelling force on our industry for better and more adequate wiring. It means that the home buyer can be shown and will understand the visible evidences of adequate wiring. The size and number of service entrance wires, the number and type of branch circuits and the adequacy of points of use and control are salable features of the home as never before.

The awakened public demand for adequate wiring and the technical requirements of modern electrical living have been brought home to builders, architects and residential appraisers in their own publications within recent months. Articles in the "American Builder," "Architectural Record," and "The Review of the Society of Residential Appraisers" have carried the story of adequate wiring. Reprints have been made available by the N.A.W.B.

Local adequate wiring promotion is tying in with home building clubs and other postwar home planning groups. The adequate wiring emblem is widely used throughout the electrical industry and the slogan, "Adequate Wiring the Key to the Home of Tomorrow" is pointing the way to sound and constructive postwar wiring practice.

The National Adequate Wiring Bureau is sponsored by the electrical industry. It's activities are under the direction of an executive committee and a plan committee appointed by the National Electrical Contractors Association, the National Electrical Wholesalers Association, the National Electrical Manufacturers Association, the International Association of Electric Leagues and the Edison Electric Institute. Herbert Metz heads the executive committee. The other members are J. S. Bartlett, V. R. Despard, H. E. Dexter, E. G. May, Ralph Neumuller, S. J. O'Brien, W. E. Parrott and A. C. Prange. The plan committee members are chairman C. M. Fife. L. W. Davis, P. N. Fleck, S. G. Hibben, G. W. Kable, H. E. Merrill, J. A. Morrison and H. B. Tompkins.

Operating your SMALL MOTOR

How one of the nation's leading small motor repair shops attains the operating efficiency and mass production to handle the volume necessary for profitable operation.

***COIL WINDERS** must be able to make all machine settings and wind coils for any job that may come into the shop.*

***STOCK OF SPARE ARMATURES** and stators of various popular sizes smooths production schedule, speeds up rush jobs and eliminates overtime work. This is a necessary part of every small motor shop stock.*

THE first and most important consideration in making small motor repairing profitable is *volume*. To handle the required volume of motors you must have proper equipment, adequately trained personnel, and an efficiently operated production system. The article "Equipping Your Small Motor Department" in the June issue of *Electrical Contracting* discussed the essential equipment and shop layout. This sequel will consider operating methods and training of personnel.

In operating a volume business on a mass production basis, time is your most expensive item. Any means devised to reduce this item per unit will increase the productive capacity of your shop—and incidentally the profit. This involves not only training of personnel, but also organization of the work schedule to utilize employees' time to the best advantage and maintain a free flow of work through the shop.

Production Line Technique

You can start saving time right at the receiving desk by designing a job card that will speed the recording of essential information. The card should be printed with a framework for all nameplate information. Writing up the job ticket then becomes merely a question of inserting check marks, numerals, dates and names. A tough manila tag board card with detachable stub and flyleaf—as a customer's copy or packing slip—works well (see illustration of flyleaf used in our shop). Both the tag and stub are serially numbered—the stub being attached to the motor to identify it by customer's name and job number. Where 25 to 50 motors are received daily, getting the units properly written up and identified is important. It is not uncommon for larger shops to receive from 75 to 100 motors daily and any saving in shop clerk's time—however slight—soon adds up to a sizable figure. Once the data is recorded the motor is ready to run the gamut of the various repair departments — and every specialized small motor shop should be departmentalized, at least to the extent of disassembly, stator winding, armature winding and assembly.

After leaving the receiving desk the motors are lined up on the disassembly bench with a pan opposite each one to receive the parts. The customer's identification stub (torn from the job card) is removed from the motor and tied to the handle of the parts pan. After the end frames and all removable small parts are removed from *all* motors and placed in their respective pans, the disassembler is ready to inspect and test the windings for physical and electrical defects. On jobs where the stators or armatures must be rewound, the job number is stamped on either or both, as the case may be, to assure all parts of the motor remaining together throughout the repair process. After this inspection and testing, the armatures and stators are placed in their respective pans and are ready to be cleaned.

Following the cleaning process the jobs are routed in three directions from the disassembly department. Those requiring no winding are sent immediately to the assembly department; those requiring rewinding go to the stator or armature winding departments — or both if necessary—parts pans included to keep all parts together and to clear the disassembly bench for incoming motors. From the winding department the motors go to the connecting bench, then through the dipping and baking process to the assembly bench where they are tested and assembled. From here they go to the final test department for load testing. The last step involves painting

*From a paper presented at the NISA War Conference in Cincinnati April, 1944.

DEPARTMENT

By M. G. Miller*
Tennessee Electric Motor Service
Knoxville, Tennessee

and then they are ready for shipment to the customer.

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To take care of emergency breakdowns you should have quite a few motors of different sizes and types in your exchange stock—the number of course depending upon the possible demand in your area. In addition to this you should also have a fair sized stock of spare armatures and stators of the more popular sizes and types. This will serve a two-fold purpose—smoothing out the winding department operation by permitting several frames and armatures of similar type to be wound at one setting and eliminating overtime work on emergency rush jobs. Although this motor stock problem is critical at present, with no units available, it should be built up as soon as conditions permit.

Taking everything into consideration, your initial investment in a stock of parts and supplies will approximate $3,000. This will gradually build up to

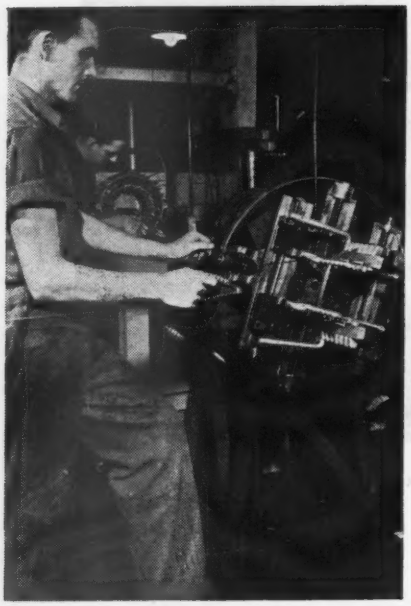
***ELECTRICAL CONNECTIONS** are made by experienced personnel on opposite side of stator winding bench.*

***NEWLY TRAINED GIRLS** in the stator winding department insert coils in motor stators. Finished stator is then slid to other side of bench.*

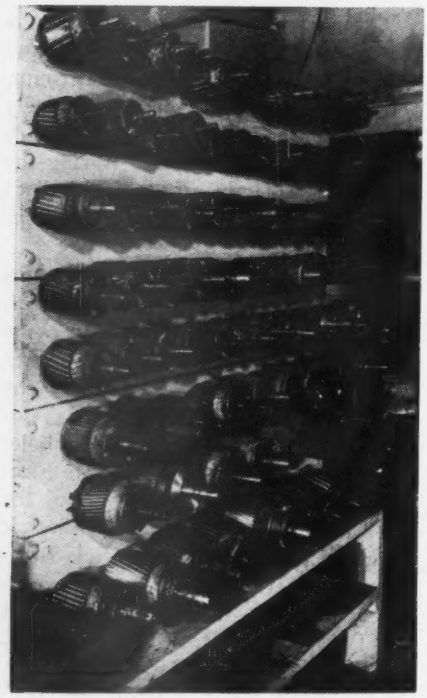
***INSULATING MATERIALS** are cut in large batches and stored in shelves ready for the motors as they progress along the shop production line.*

Operating your SMALL MOTOR D

How one of the nation's leading small motor repair shops attains the operating efficiency and mass production to handle the volume necessary for profitable operation.



***COIL WINDERS** must be able to make all machine settings and wind coils for any job that may come into the shop.*



***STOCK OF SPARE ARMATURES** and stators of various popular sizes smooths production schedule, speeds up rush jobs and eliminates overtime work. This is a necessary part of every small motor shop stock.*

THE first and most important consideration in making small motor repairing profitable is *volume*. To handle the required volume of motors you must have proper equipment, adequately trained personnel, and an efficiently operated production system. The article "Equipping Your Small Motor Department" in the June issue of *Electrical Contracting* discussed the essential equipment and shop layout. This sequel will consider operating methods and training of personnel.

In operating a volume business on a mass production basis, time is your most expensive item. Any means devised to reduce this item per unit will increase the productive capacity of your shop—and incidentally the profit. This involves not only training of personnel, but also organization of the work schedule to utilize employees' time to the best advantage and maintain a free flow of work through the shop.

Production Line Technique

You can start saving time right at the receiving desk by designing a job card that will speed the recording of essential information. The card should be printed with a framework for all nameplate information. Writing up the job ticket then becomes merely a question of inserting check marks, numerals, dates and names. A tough manila tag board card with detachable stub and flyleaf—as a customer's copy or packing slip—works well (see illustration of flyleaf used in our shop). Both the tag and stub are serially numbered—the stub being attached to the motor to identify it by customer's name and job number. Where 25 to 50 motors are received daily, getting the units properly written up and identified is important. It is not uncommon for larger shops to receive from 75 to 100 motors daily and any saving in shop clerk's time—however slight—soon adds up to a sizable figure. Once the data is recorded the motor is ready to run the gamut of the various repair departments — and every specialized small motor shop should be departmentalized, at least to the extent of disassembly, stator winding, armature winding and assembly.

After leaving the receiving desk the motors are lined up on the disassembly bench with a pan opposite each one to receive the parts. The customer's identification stub (torn from the job card) is removed from the motor and tied to the handle of the parts pan. After the end frames and all removable small parts are removed from *all* motors and placed in their respective pans, the disassembler is ready to inspect and test the windings for physical and electrical defects. On jobs where the stators or armatures must be rewound, the job number is stamped on either or both, as the case may be, to assure all parts of the motor remaining together throughout the repair process. After this inspection and testing, the armatures and stators are placed in their respective pans and are ready to be cleaned.

Following the cleaning process the jobs are routed in three directions from the disassembly department. Those requiring no winding are sent immediately to the assembly department; those requiring rewinding go to the stator or armature winding departments — or both if necessary—parts pans included to keep all parts together and to clear the disassembly bench for incoming motors. From the winding department the motors go to the connecting bench, then through the dipping and baking process to the assembly bench where they are tested and assembled. From here they go to the final test department for load testing. The last step involves painting

*From a paper presented at the NISA War Conference in Cincinnati April, 1944.

DEPARTMENT

By M. G. Miller*
Tennessee Electric Motor Service
Knoxville, Tennessee

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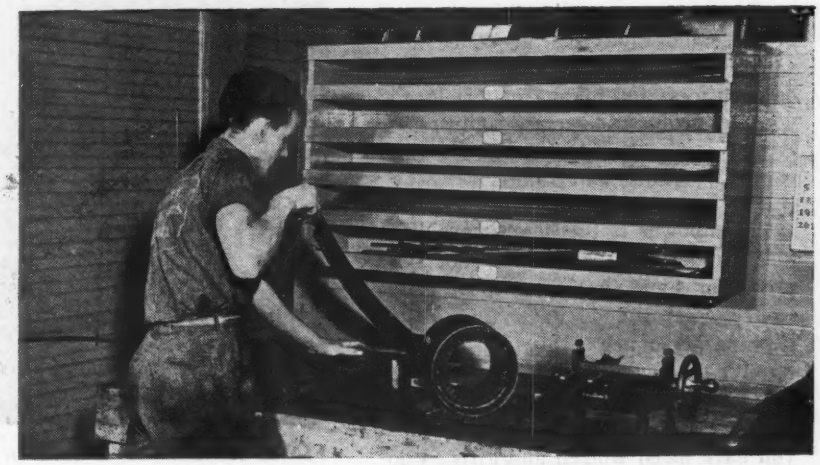

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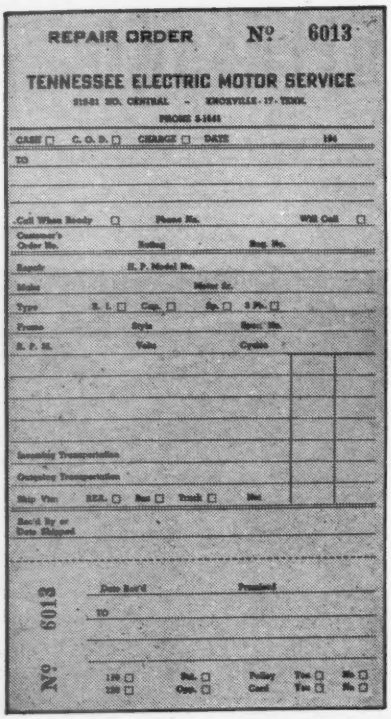


REPAIR ORDER Nº 6013

TENNESSEE ELECTRIC MOTOR SERVICE

***JOB TICKET** fly leaf indicates type of job card designed for quick and complete recording of essential data. Stub is torn off bottom of card and attached to motor when it leaves the receiving desk to go through the repair process.*

about $5,000 to $7,000 and should and will increase in direct proportion to your increase in volume of work. If we add to this the cost of equipment ($6,000 to $8,000) outlined in the article in the June issue of *Electrical Contracting* you will have a total investment of approximately $9,000 if you go into the business on a "feeler" basis, and an investment of about $11,000 if you begin on an "all-out" basis. There is one thing to remember—if you do a good job on small motors, the manufacturers will learn about you sooner or later. Placing yourself in a position to obtain manufacturers' authorized service contracts will build up your prestige and give you the added advantage of obtaining spare parts at better prices, thus adding materially to your net profits and service facilities.

Training Personnel

Manpower is the biggest problem today and the situation may not improve for some time after the war is won. What you do in obtaining and training personnel at this time will determine your success or failure. If you haven't hired all the 4-F's you could get hold of—you should have. Perhaps you have hired women and girls to do such work as insulating, coil winding, inserting coils, connecting simpler jobs and even to help on the assembly bench. But you can't expect untrained personnel of this type to take over shop operation completely. Small motor repairing is a *technical trade* and such help has not been in the business long enough to master it. You must have someone in your organization that has a practical knowledge of small motor repairing to realize a profit from the business.

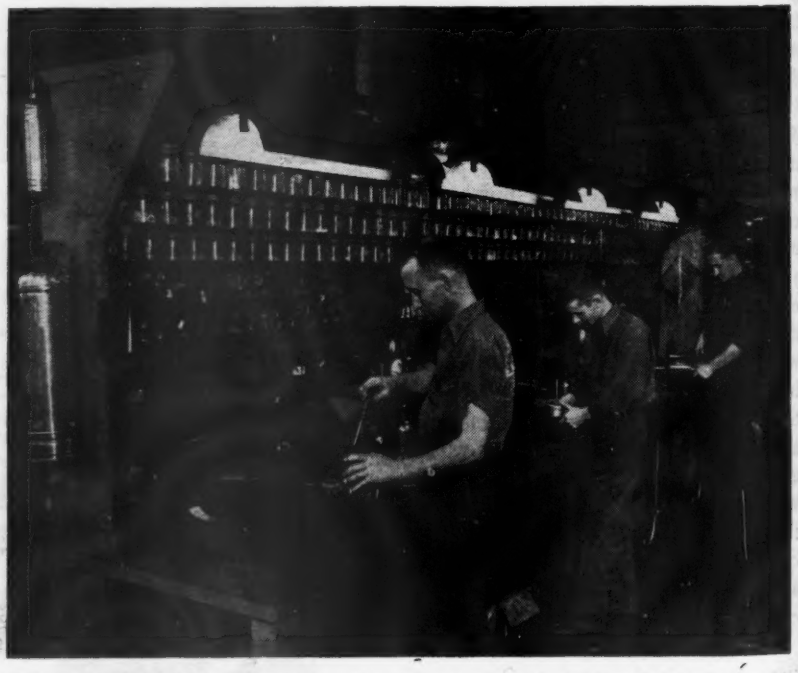
If you are operating a small motor repair department — and have not already done so—you should start a training program now. Small motor repairing is just beginning to find itself as a major phase of the electrical industry and there just aren't enough masters of the trade to fill the jobs in your shop—nor would there have been in normal times. It's a question of training men for an expanding service industry.

The quickest method of training for efficient production is to teach the beginner how to do only a certain phase of the repair routine and not try to make an overall mechanic out of him. Careful consideration should be given to the beginner's technical knowledge, mechanical aptitude and physical coordination. As an example—girls who know nothing about the theory of motors or how to connect them might make good coil winders, coil insulators, and so on. The basic functional jobs for which new personnel in small motor repair shop work can be trained are as follows: shop clerk, disassemblers, strippers, coil winders, stator winders, armature winders, and assemblers. One way of increasing assembly production output is to break the work down into types—one group of assemblers specializing on repulsion-induction motors; another group on capacitor and split-phase types.

A successful training program depends upon three major factors: (1) the right ideas; (2) the necessary material with which to work; and (3) the ability to solicit the faithful cooperation of other people. The training program responsibility should not rest entirely on the shoulders of your shop foreman but should be shared with the heads of the various departments. By doing this each department will stand out by itself as an operating unit. Trainees can thus be instructed by the respective department heads to do the work of that department alone. Each key man should arrange the work of his department in such a manner that, in addition to training new help, he will have the time and opportunity to do the complicated jobs, keep production on schedule and synchronize all departments so that the assemblies can be kept going at top speed at all times.

In conjunction with your training program you should formulate a clear-cut set of job standards and let the workers know what these are. Knowing what qualifications are required for the various jobs will give them a goal to attain and will help to clarify the reasons for whatever rate differentials there might exist between the different

[Continued on page 99]



***FINAL ASSEMBLY** is done in this department where bench is equipped with necessary test equipment and thousands of small parts and accessories within easy reach. From here motors go to dynamometer for final test, then are painted and shipped out.*

JOB STANDARDS CHART FOR THE SMALL MOTOR SHOP

(Approved by the War Manpower Commission)

Department and Title	Duties of Personnel
SUPERVISORY	
General Foreman	1. Coordinate work in all departments. 2. Give estimates and prices on all jobs. 3. Give job delivery dates and follow through. 4. Assist all departments in training program. 5. Assist on special or complicated jobs. 6. Inspect and accept or reject finished work. 7. List parts to be ordered for special jobs. 8. Anticipate needs and list parts for stock replacement. 9. Recommend hiring or dismissal of shop employees. 10. Take employee grievances to office. 11. Properly fill merchandise orders. 12. Be subject to emergency service call at all times.
CLERICAL DEPT.	
General Shop Clerk	1. Receive and route incoming shipments. 2. Write repair orders, record same and transmit for Foreman any special instructions. Check and record repair order numbers on all Bills of Lading, Purchase Orders and letters concerning jobs. 3. Greet and wait on customers for repair work and purchases. 4 Supervise and properly file repair orders while job is in shop. 5. Write up Bills of Lading, call transportation companies, make labels, etc., on jobs to be shipped. 6. Assist in general office work in spare time.
Shop Clerk	1. Duties same as for general shop clerk except omit No. 5.
DISASSEMBLY DEPT.	
No. 1 Disassembler	1. Select proper jobs to disassemble to maintain correct work schedule. 2. Mark and record all motors, pump assemblies, etc., so proper re-assembly can be made. 3. Disassemble, test windings; record findings for transmittal to shop clerk and foreman so proper pricing and work schedule can be maintained on all types of jobs. 4. Direct work of and instruct No. 2 disassembler. 5. Assist assemblers in spare time.
No. 2 Disassembler	1. Same as (3) for No. 1 disassembler except on simple type motors only. 2. Wash motors and deliver all winding jobs to winding dept. 3. Assist assemblers in spare time.
STRIPPING DEPT.	
No. 1 Stripper	1. Record and stencil job number on data cards and motor frame; count and record turns and wire size on data cards; strip out old wire; remove old commutators, governor weights, fans, etc., from armatures and place in proper pans; remove old insulation; clean slots; straighten laminations on both armatures and stators. 2. Select, cut and fit insulation in armatures and stators. 3. Dip, clean and place all jobs in oven. 4. Assist other department employees in spare time.
No. 2 Stripper	1. Strip out old wire after data has been taken; remove old insulation; clean slots and straighten laminations. 2. Assist in dipping, cleaning and placing all jobs in oven. 3. Assist other department employees in spare time.
STATOR WINDING DEPT.	
Foreman	1. Take data and draw working diagrams of all special jobs; give stock order requirements to shop foreman. 2. Lay out and superintend work of all department employees. 3. Wind the more difficult and complicated jobs. 4. Train beginners in all stator-winding operations. 5. Recommend to shop foremen the hiring and dismissal of department employees. 6. Communicate employee grievances to office. 7. Be subject to emergency service call at all times.
No. 1 Stator Winder	1. make machine settings and coils for any job. 2. Insert coils in any job. 3. Be able to connect any job from diagram. 4. Select, cut, and fit insulation in any job. 5. Assist other department employees in spare time.
No. 2 Stator Winder	1. Insert coils; select, cut and fit insulation and connect from diagram all simple type jobs. 2. Assist other department employees in spare time.
No. 1 Coil Winder	1. Make machine setting and wind coils for any job. 2. Assist other department employees in spare time.
No. 2 Coil Winder	1. Make machine settings for most popular type jobs; wind coils for any job after settings have been made. 2. Assist other department employees in spare time.
ARMATURE WINDING DEPT.	
Foreman	1. Take and record on cards data on all special jobs.
No. 1 Armature Winder	2. Insulate and install commutators; wind, connect, test, clear trouble, band and solder any type job. 3. Train winders in this department. 4. Give stock order requirements to shop foreman.
No. 2 Armature Winder	1. Insulate, wind, connect and band all simpler and smaller armatures. 2. Assist other department employees in spare time.
Armature Winder's Helper	1. Clean slots; insulate all armatures and install simpler commutators. 2. Connect and test Delco loop wound armatures. 3. Solder simpler jobs; dip, clean and place all jobs in oven. 4. Assist other department employees in spare time.
ASSEMBLY DEPT.	
RI AND 3-PHASE MOTORS	
No. 1 Assembler	1. Determine need of and replace all worn parts, do necessary general machine work including balancing, fit parts and solder commutators; assemble, connect, test, analyze and correct trouble test might show on all RI and 3-Phase motors. 2. Direct work of and teach No. 2 assembler and helpers 3. Give stock order requirements to shop foreman.
No. 2 Assembler	1. Same as (1) for No. 1 assembler except on simple RI motors only. 2. Do minor finish-up work on RI and 3-phase motors, such as installing conduit boxes, last through bolts, nameplates, bases and mountings, oil wicks, dust covers, oil and paint.
Assembler's Helper	1. Press in and ream bearings; solder and turn commutators, repair parts; install leads and scrape stators on simpler jobs. 2. Same as (2) for No. 2 assembler. 3. Assist assemblers in spare time.
CAPACITOR AND 3-PHASE MOTORS	
No. 1 Assembler	1. Determine need of and replace all worn and defective parts, do necessary general machine work; fit parts and solder rotors; assemble, connect, test, analyze and correct trouble test may show on all type capacitor, split-phase and 3-phase motors. 2. Direct work of and teach No. 2 assemblers and helpers. 3. Give stock order requirements to shop foreman.
No. 2 Assembler	1. Same as (1) for No. 1 assembler except on simpler type capacitor and split-phase motors only. 2. Do minor finish-up work on capacitor, split-phase and 3-phase motors such as installing conduit boxes, last through bolts, nameplates, bases and mountings, oil wicks, dust covers, oil and paint.
Assembler's Helper	1. Press in and ream bearings on simpler jobs; solder and clean rotors, scrape stators. 2. Same as (2) for No. 2 assembler. 3. Assist disassemblers in spare time. 4. Pack finished motors for shipment.

What to do About

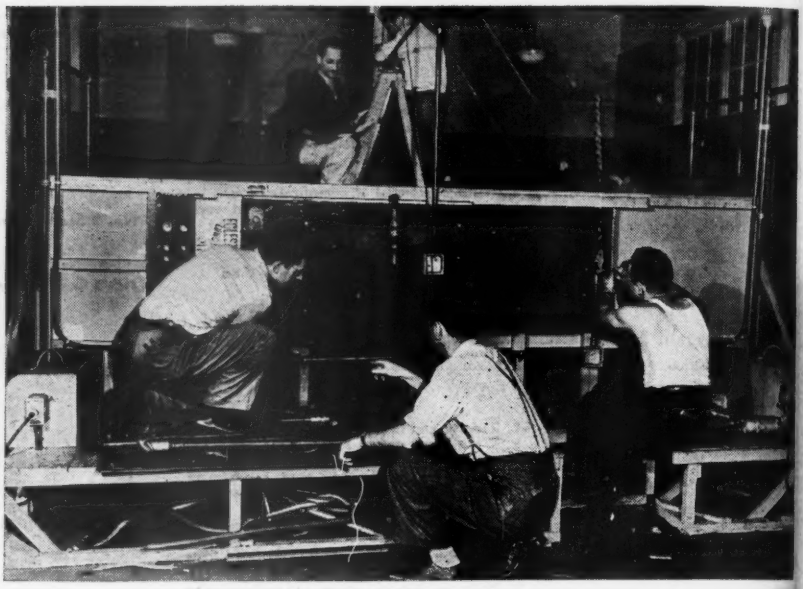
ELECTRICAL fires are costly, from the point of view not only of property losses but of interruptions to war production.* In all types of occupancies, there were an estimated 73,000 such fires, causing property losses of $28,000,000, in 1942, the latest period for which figures are available.

At the present time, approximately one in every four industrial fires has an electrical origin, according to the National Fire Protection Association. Overloading of equipment, improper maintenance, the rapid rate at which electrical apparatus has multiplied both as to quantity and consumption of power, the scarcity of critical materials and the consequent use of substitutes, and lastly the speed with which a great deal of equipment necessarily has been installed in war plants, have all contributed to an increased number of fires from electrical causes.

It is usually not the heavy types of equipment, such as generators and motors in engine rooms, maintained by competent engineers, that are the sources of fires, but the small electrical equipment and motors spread throughout the plant. While there is no substitute for proper servicing of equipment, at least a partial safeguard against inadequate maintenance is extra care in installation. When one realizes the extent of use of electricity in the modern industrial plant and the hundreds of places where fire might occur should the electrical system not be properly installed, the responsibility of the electrical contractor to war production is readily understood.

The growth of spray painting and the introduction of a larger number of flammable solvents in various industrial processes make electrical installations in such hazardous locations an increasingly important task. The National Electrical Code should be rigidly adhered to in such locations. In the accompanying tabulation are listed two serious fires in spray booths due to improper installations.

No motor, lamp or lighting fixture of any type should be located within spray booths, in ventilating ducts, or in any location where there is possibility of spray lodging upon them. Motors located outside of the hazardous area in spray painting departments should be of the totally enclosed type or of the open induction type having no brushes, make-and-break contacts, collectors, or other arcing or sparking parts. Portable lamps should be eliminated wherever possible. If they are necessary, they should be enclosed in a manner suitable for explosive atmospheres.



***DURING INSTALLATION** of electrical equipment, extinguishers of suitable types should be readily available. The extinguisher shown here is of the vaporizing liquid type.*

Because of the increased use of flammable paints and liquids in modern industry, the electrical contractor should be familiar with their properties in order to know when and where a hazard exists during installation of electrical equipment. Moreover, suitable fire extinguishing equipment should be on hand, ready for immediate use, should a fire occur. Speed in attacking a fire is imperative simply because any fire is more easily extinguished when it is small. The National Fire Protection Association has estimated that from 70 to 90 percent of all fires that start can be—and ordinarily are—put out with first aid fire appliances.

Three Types of Fires

The Underwriters' Laboratories, Inc., recognizes three types, or "classes," of fire, designated as A, B and C. "Class A" fires are those in ordinary combustible materials, such as wood, paper, rubbish, etc. "Class B" fires are those occurring in flammable liquids, and "Class C" fires are those in live electrical equipment.

Class C fires require the use of extinguishing agents that will neither damage the equipment nor convey an electrical charge to the operator. Vaporizing liquid (specially processed carbon tetrachloride) and carbon dioxide extinguishers are safe for use on fires of this class. In some cases, however, fires in heavy electrical equipment may require the cooling and quenching effect of large quantities of water. The current should, of course, be shut off in such cases. Both vaporizing liquid and carbon dioxide are non-conductors, this being the reason they are approved by Underwriters' Laboratories for Class C fires. They form a heavy vapor or gas that shuts off the oxygen supply, thus smothering fire.

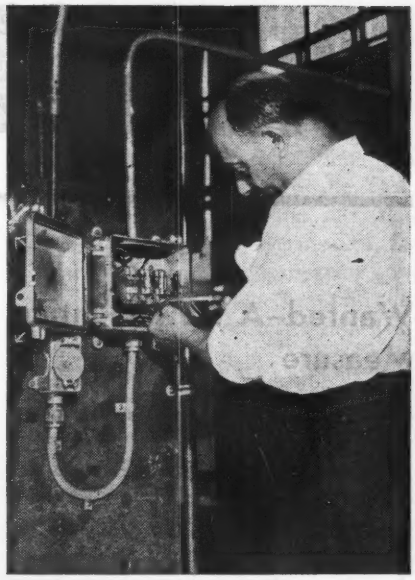
Fires in flammable liquids, Class B, may be suitably extinguished with foam, vaporizing liquid, carbon dioxide and loaded stream extinguishers. Fires in ordinary combustibles, Class A, may be put out with any approved extinguisher but those which contain water or chemicals and water are most effective.

Vaporizing liquid extinguishers of the familiar pump-gun type, as a matter

Electrical Fires

Precautions and first aid for fires starting from electrical apparatus.

By H. P. Quadland, *Safety Research Institute*



***CAREFUL INSTALLATION** of electrical equipment in accordance with the Code will minimize later fire hazards.*

IMPORTANT FIRES WITH ELECTRICAL CAUSES
December 7, 1943, to March 7, 1944
(Source: National Fire Protection Association)

DATE	LOCATION AND TYPE OF OCCUPANCY	CAUSE OF FIRE	LOSS
December 3, 1943	Metal working plant, Los Angeles, Cal.	Shorted wiring, due to rain filling conduit box	$100,000
December 25, 1943	Supermarket, Pontiac, Mich.	Blaze started from "electric motor on a refrigerator unit"	$150,000 to $190,000
December 30, 1943	U.S.O. Building, Olympia, Wash.	Short circuit in electric wiring	$87,109
January 4, 1944	Magnesium castings plant, New York, N. Y.	Portable electric grinder coming in contact with foreign material at metal enclosed booth	One life lost; several persons badly injured; monetary loss not reported
January 12, 1944	Chemical works, Nichols, Cal.	"Fire believed due to a portable electric heater"	$200,000
January 19, 1944	Wire and sheet metal works, St. Louis, Mo.	Ignition of residue in paint spray booth by improperly arranged receptacles	$33,500
February 3, 1944	Bus garage, Clifton, N. J.	"Electric spark from broken extension light ignited gasoline"	$51,525
February 8, 1944	Prefabricated houses plant, near Lafayette, Ind.	"Portable lights were used while spraying." Light bulb broke, igniting naphtha fumes	$270,000 3 lives lost; 3 persons severely burned

of common practice, are suspended in wall brackets near electrical apparatus. Remove the extinguisher by grasping the handle in the right hand and pulling outward. Hold the bottom of the extinguisher in the left hand. Twist the handle to unlock it and pump it steadily and vigorously at the base of the fire, not at the smoke and flames.

Larger sizes—1, 2 and 3-gallon capacity—utilizing either hand-pump or stored pressure are sometimes provided for special hazards. The stored-pressure type is operated by opening the valve, provided on the head castings, with the left hand while the right holds the hose nozzle.

Carbon dioxide extinguishers are carried to the fire with the left hand grasping the handle. To operate, the extinguisher is rested on the ground, the locking pin extracted, and the valve turned counter-clockwise with one hand to release the gas and the horn-like nozzle directed at the seat of the fire with the other hand.

When fighting a fire, stand as far from it as effective use of the extinguisher will permit. The stream of vapor or gas should be maintained after the flames have been extinguished to make sure there are no glowing remains or sufficient heat to cause the fire to break out anew.

General safety of the fire-fighter should be kept in mind. A position should be taken between the fire and an exit, in order to allow ready escape. If the fire is outdoors or in the path of a heavy draft, it should be fought with the back to the wind. Immediately the fire is out, the place should be thoroughly ventilated.

It would be well for electrical contractors to have at least one man on the installation crew who knows the most effective methods for extinguishing small fires.

With the multiplicity of electrical apparatus in modern industry, greater fire-consciousness on the part of the contractor can help to eliminate many sources of electrical fires. From the viewpoint of the contractee, cost should not be a deciding factor, for the price of added protection is infinitesimal by comparison with loss of life or loss of plant and consequent interruption to production.

EDITORIALS

W. T. Stuart, *Editor*

Wanted—A New Lighting Measure

The control of brightness contrast is the next great step in the progress of lighting system design. Glare is the enemy of good lighting. Its effect is negative. The brighter the glaring source the more difficult it is to see. And as practical lighting levels break into new high intensities the elimination of glare rises as one of the most important challenges before the lighting industry as we look ahead to postwar opportunities.

The challenge is properly a commercial one. The technical features of fixture and lamp design that reduce or eliminate bright areas in the field of vision are well known and readily available to the trade. There is still, however, a need for a better understanding of glare and its relation to good lighting among the people of our own industry and our customers.

Foot-candles are salable. Intensity can be demonstrated and is subject to measurement on a simple instrument. It is easy to understand and to explain. Obvious glare, as for instance, a clear incandescent lamp in a room without other illumination, is also easy to demonstrate and explain to the customer. But glare can be and usually is much less obvious. The eye tends to adapt itself to glare as readily and unconsciously as it adapts to different intensities of useful light. And just as the eye continues to function far below adequate intensities for its seeing task before there is an actual sense of discomfort, so with glare. Gross differences of brightness measurable on an instrument or obvious on a photographic film can be present without physical sense or apparent discomfort.

In installation practice, however, bare lamps cannot be shielded from direct view, louvered, or the light diffused through glass or other covers without a net loss in foot-candles. And there is the nub of the commercial problem. The higher intensities available from a bare lamp job must be sacrificed in the interests of better illumination and the elimination of glare.

Glareless lighting or lighting systems with minimum brightness contrast actually provide better seeing than systems of higher intensity but greater contrast. What we need is a new measure of lighting systems providing comparison on total quality rather than intensity alone. Though foot-candle measurements and brightness contrast ratios are available for technical comparisons, the real need is a commercially useful and demonstrable method of rating that can be readily understood by the customer.

Parts Requirements Come First

While a good deal of thought is going into new civilian products to take the place of rapidly depreciating appliances, the parts situation is still acute. Irons are in production while heating elements for replacement in existing irons are critically scarce, for example. And the same condition holds true all down the line of appliances. Radio tubes, fractional horsepower motors and refrigerator parts are so scarce as to cause a piling up of repair orders which in turn is creating a still larger demand for new appliances.

And nobody wants a large program of new civilian products now. Some, certainly, to fill the very real needs are justified. But a well ordered plan for the manufacture of needed parts for the equipment we already have will help to stem the tide of public demand until the war job tapers off and the labor, materials and facilities can be put to work with permanently beneficial economic results.

Refrigeration Is Reversible

One bright hope on the horizon for practical electrical heating systems is reverse cycle refrigeration. The safety, cleanliness and convenience of heat without local combustion may well come sooner than we expect. Already tested on an experimental scale, heat pump installations may conceivably usher in a new era of electrical living.

Reverse cycle refrigeration removes heat from the outside air and dissipates it indoors. Though the outside temperatures may seem very cold the air reduced to a lower temperature gives off heat which is discharged at the condenser. This heat transfer plus the electric energy consumed by the apparatus provides the necessary heat units to heat the house to a comfortable temperature.

The heat transfer principle involved provides a gain of about three times the electric energy input. The resulting energy costs are within the range of other heating systems.

While the first installations of heat pumps will probably be limited to luxury level jobs, mass production and national promotion may eventually bring the system within reach of a wide segment of the buying public. And all-electric indoor climate control opens a vast new field for our industry.

Connectors Denote Easy Maintenance

Examining an elaborate aircraft gadget one day we noted the way it was hooked up. Though about 30 wires were connected to the terminal board the entire rig could be removed by removing two bolts. A compact separable connector handled all the wiring connections.

Fast maintenance and ready replacement of equipment is the very essence of fighting aircraft design. And the urgent needs have fostered the development of devices to speed maintenance at a rate that has squeezed years of normal progress into months. It is inevitable that such connectors will find their way into conventional wiring after the war.

While there is nothing new about the use of separable connectors for

portable apparatus, their use for convenient maintenance has been rare. Yet they offer a chance for very real improvement in wiring methods and apparatus design. Motors and control devices on critical production jobs could be quickly replaced without interference with complex wiring connections. Lighting fixtures could be quickly removed for on-the-floor maintenance. Apparatus or devices subject to severe wear or frequent breakdown could be made readily removable. These obvious uses will suggest many others.

It is noteworthy that new demands for quick and easy electrical maintenance comes at a time when we have a high order of precision and reliability in separable connectors. And the connectors may eventually become the hallmark of wiring design for speedy maintenance.

Codigo Electrico Nacional

Which is one way to say the *National Electrical Code*. It is the title of the edition which has been prepared by NEMA to carry the gospel of American standards for wiring and apparatus to Latin America. Spanish is a more wordy language so the little book runs 423 pages as compared with the 360 pages in the original. Otherwise it has the same size and general appearance as the English edition.

Translation of the Code into the tongue of our neighbors is both good statesmanship and good business. Latin America is and will be a good customer for electrical products of all kinds. And they will find in the Code our accumulated experience with the installation and use of these products toward adequate standards of electrical safety. And out of safe wiring practices in their own lands will come more satisfaction and greater confidence in the wiring materials they buy from us.

Maintenance Rigs Show Progress

Time was when electrical maintenance was a fix-it job. Something stopped or broke or heated up and a mechanic fixed it and that was that.

Now, in most big plants anyway, electrical maintenance is a highly organized procedure of prevention as well as cure of electrical troubles. There are timed routine of replacement and regular schedules of inspection and cleaning and oiling. And the whole trend of management thinking is toward considering preventive maintenance as directly allied to production.

And as the relative importance of good maintenance has grown men have devised special tools and methods and today there is an impressive array of machines and tools and special devices to speed and organize the job.

Maintenance trucks with compartments for a store room full of parts and tools now replaces the back breaking tool kit. Portable compact instrument sets give all the dope in one setup. Scaffolds on pneumatic tires, crane platforms and highly maneuverable and adjustable crows nests reach up to lighting systems.

The progress of man is marked by the tools he has devised. And the development of maintenance methods and machines is impressive evidence of rapid progress in that field.

Advance Orders Now Placed

At least one retail store chain has placed a binding order for a large number of commercial fluorescent lighting fixtures for postwar delivery. All of its stores will be relighted and it wants to be in a position to get preference on deliveries when normal manufacturing is resumed. Plans are made and the jobs are ready to go.

There is a warning here for those contractors specializing in lighting installations. It is not too soon to get the groundwork laid for their customers. The commercial advantage that modern lighting gives the retailer is important and, in the postwar era, may be critical. Some shrewd planners will be sewing up the first of the available lighting equipment to gain an important strategic advantage over their competitors. And from the apparent prospects in the lighting field the folks who are left at the end of the line may have a long wait.

Thousands of stores have lighting jobs waiting for the release of commercial fixtures. There is no uncertainty or qualification. They are ready and anxious to move as soon as they are permitted. It is up to us to get these prospects lined up now on definite plans and firm orders.

Washington Notes

▶ Invasion plans worked out better than many military leaders dared to expect. Washington plans for reconversion and postwar preparations may be expected to come into the foreground now, not with the idea that the war is won, but because of the pressing urgency for preparing our economy for the impact of cutbacks and the eventual peace. Industrial firms which want to go ahead on the preparation of design models of postwar products now have access to the necessary materials. Realignment of war production requirements and even colossal new war programs are still possible, however, as happened on big guns and trucks.

▶ Production of 100,000 fans in 12-inch and 16-inch sizes will be permitted after assignments of production quotas can be made without interfering with war production. The number will permit meeting only the most essential military, hospital and industrial needs.

▶ Heavy demands for small motors are coming from farm areas. Manpower shortages and large cash incomes are turning the farmers to electric power applications to take over as much of the farm work as possible.

▶ No production of new radio sets is likely this year. Materials for heating system controls have been made available to manufacturers and installers will be able to buy the controls freely.

▶ Metals are generally in good supply, meaning satisfactory within the present materials controls, but few relaxations of regulations are in immediate prospect. Paper is one of the real problems of the moment and becoming more serious.

▶ Manpower is more than ever the determining factor in production planning. No relief is predicted.

▶ WPB is urging the training of electrical appliance repairmen by groups of local shops. OCR field men will help and WMC will set up the training program if requested. Actual on-the-job instruction methods are advised.

▶ New construction total for April was $284,813,000 with May estimates indicating the first upturn in 21 months. Military construction amounted to $46,120,000, new housing $61,000,000, all other non-industrial $110,000,000. Government financed industrial plant expansion totalled $147,845,000 including equipment.

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PRACTICAL METHODS

KNOWLEDGE OF CIRCUITS AIDS TROUBLE-SHOOTING D-C CONTROL—NO. 4

CONTROL

By L. E. MARKLE*

Fig. 12 shows one form of dynamic braking control. The main line contactors (forward and reverse) are multi-pole type having two normally open contacts (for example the two marked F for forward run) and one normally closed contact (FA).

As in Fig. 7, the accelerating contactors 1A and 2A are open when energized. That is, coil $1A_m$ is energized through normally closed auxiliary contacts Fa_2 and Ra_2. Accelerating contact 1A opens, and its auxiliary contact 1Aa closes energizing coil $2A_m$. Contact 2A opens, auxiliary contacts $2Aa_1$, $2Aa_2$ and $2Aa_3$ close setting up the control circuits for a forward or reverse start.

Now suppose the FORWARD button is pressed, the coil of contactor F is energized (through contacts $2Aa_1$ which are now closed), the two main line contacts F close and the braking resistor contact FA opens. Normally closed auxiliary contact FAa opens providing electrical interlock between forward and reverse contactors. As F closes, auxiliary contact Fa_1 closes (providing the holding circuit across the forward button), Fa_2 opens de-energizing $1A_m$, and $1A_n$ starts timing. 1A closes at the proper time, 1Aa opens de-energizing $2A_m$, and $2A_n$ starts timing. After 2A closes the motor runs at full speed.

When either the STOP or REVERSE button is pushed contactor F drops out, contact FA closes, setting up a dynamic braking circuit through the braking resistor. At the same time coils FA and RA which are energized by the counter-emf of the motor, hold contactors RA and FA closed (and R and F open) preventing plugging of the motor armature. These coils hold the contacts RA and FA closed until the braking current drops to a low value, so that even if the REVERSE button were pressed during the braking period, contactor coil R would not have sufficient strength to overcome the pull of the RA coil until the motor had almost stopped.

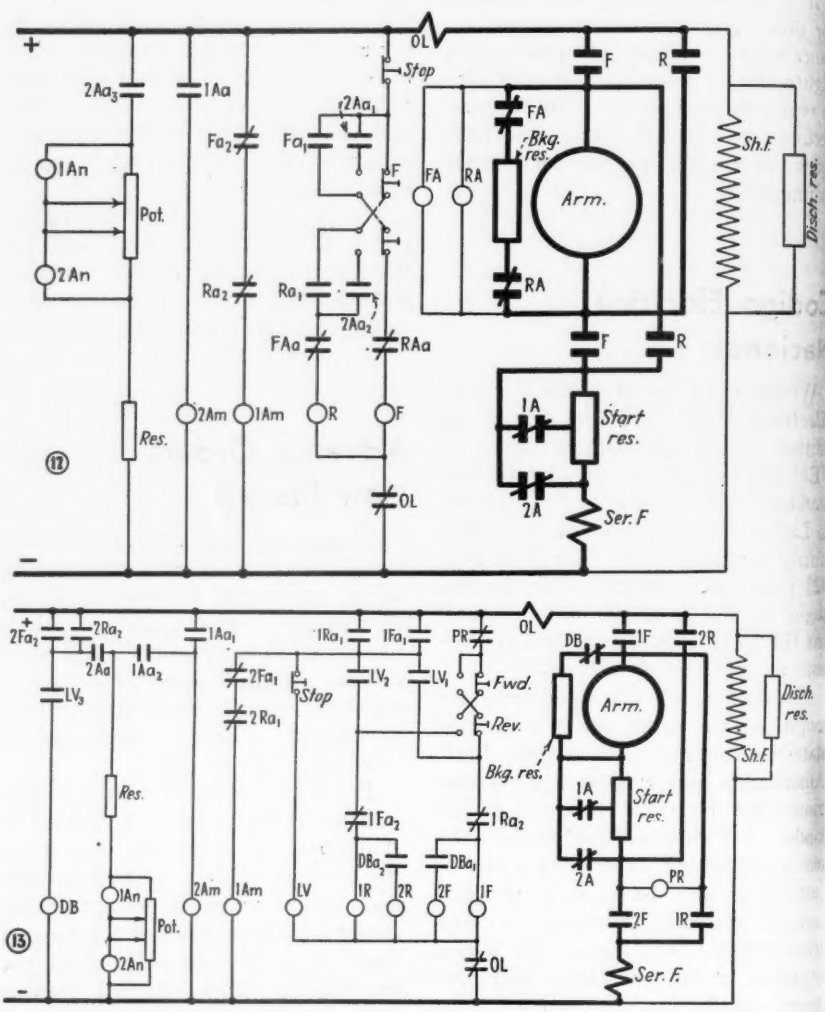

Fig. 13 is an example of another form of reversing dynamic braking. A spring-closed dynamic braking contactor is used along with single-pole, normally-open directional contactors. Pressing the FORWARD button energizes coil 1F closing the main line contactor 1F and auxiliary contact $1Fa_1$ and opening $1Fa_2$ providing electrical interlock between the forward and reverse contactors. Closing $1Fa_1$ energizes coil LV, closing three LV contacts, including LV_1 which sets up the holding circuit. $1A_m$ also becomes energized opening main accelerating contact 1A and closing auxiliaries $1Aa_1$ and $1Aa_2$. $2A_m$ then becomes energized, opening 2A and closing $2Aa_1$ which energizes coil DB, opening contacts DB and closing the auxiliaries DBa_1 and DBa_2. 1R and 2R do not

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PORTABLE POLARITY CHECKER FOR ELECTRIC DRILLS AND CORDS

MAINTENANCE

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The plant electrical maintenance department has devised and built a simple test set for checking the polarity and ground connections on the cords of these electric tools and extensions. It consists of a box-like panel, 12-inches long, 9½-inches high and 1¾-inches deep with a 1¾-inch mounting for a 120/20/10-volt transformer. (See Fig. 1) Other equipment includes one male recessed 3-prong plug, one single 3-prong receptacle, a duplex, 3-wire receptacle, a ground test post and the necessary indicating lights.

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Mechanical ground connections on lamp cords and electric tools are checked by plugging the cord into receptacle "B" (see Fig. 2) and bringing the metal case in contact with the ground post "E". If the connection is proper, the circuit will be completed and the green jewel "G" will light up. If the ground is broken, the lamp will not light.

The duplex receptacle "C" and "D" is connected directly across the 120-volt line and is used primarily for short test runs on drills or other electric tools. Drill motor lead and cord connections are also checked by plugging the drill into receptacle "B". If all connections are in order, none of the red jewels, 1, 2, and 3 will light up. If there are any cross connections or something is wrong with the windings, two of these red lights will burn and the drill is returned to the repair department for recheck, reconnection, or repair.

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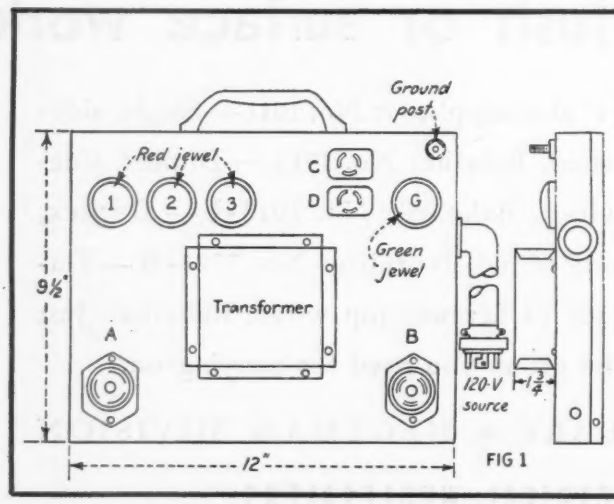

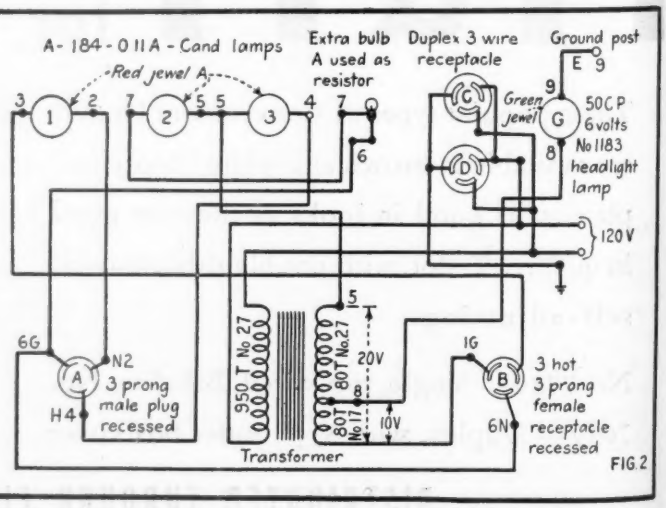

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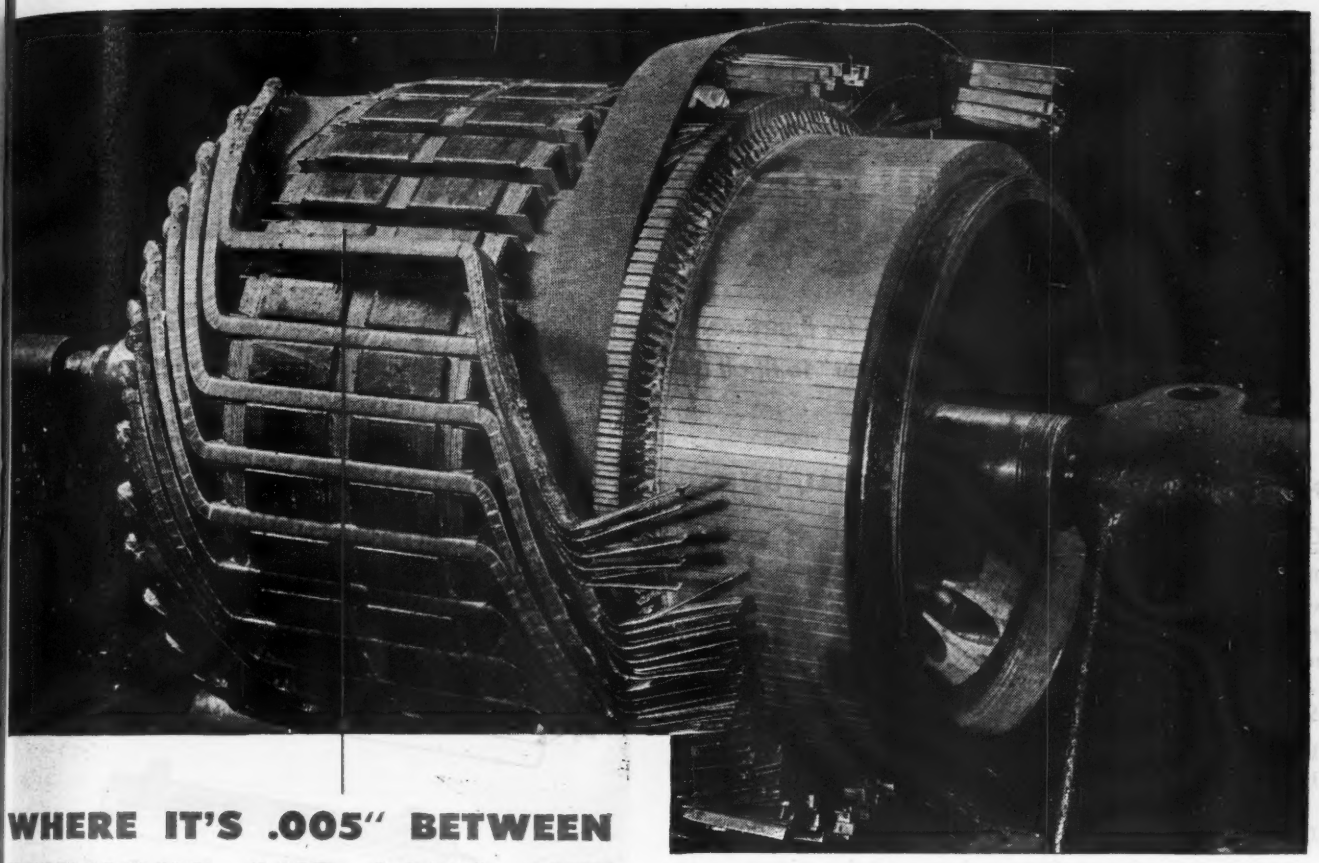

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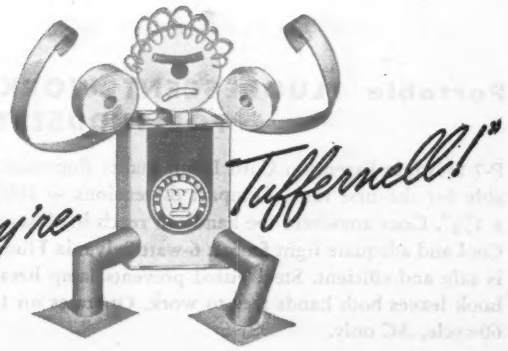

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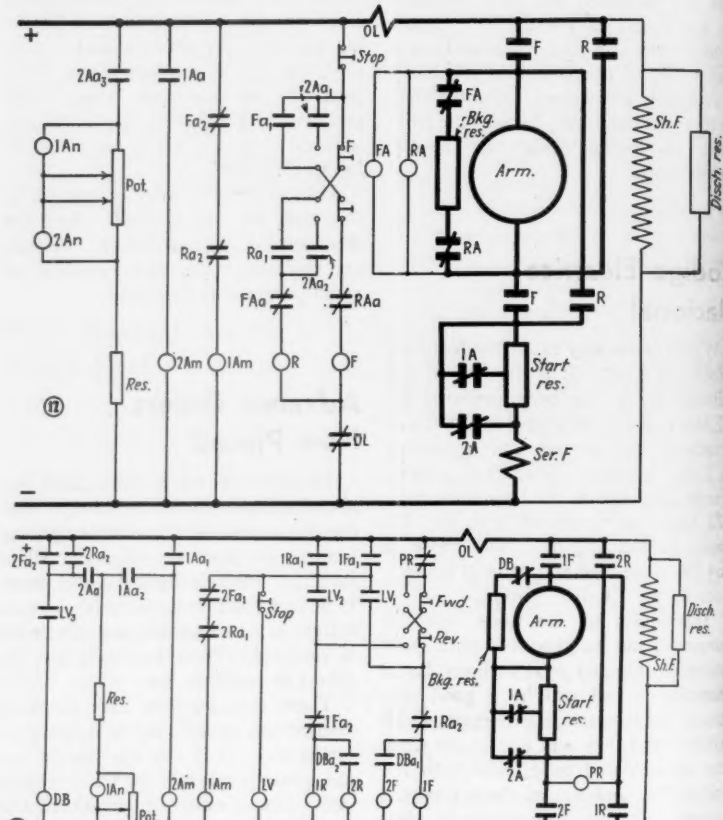

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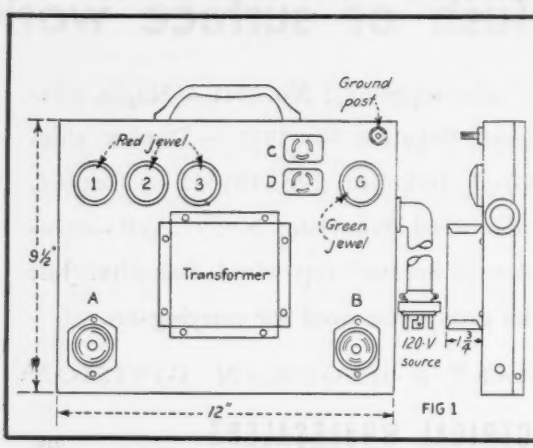

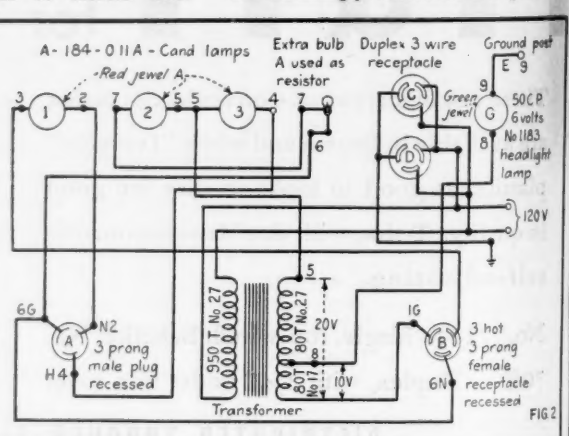

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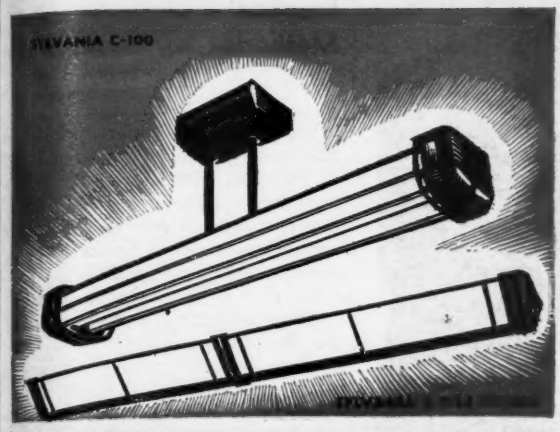

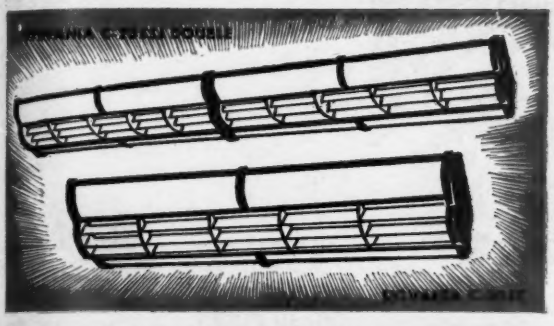

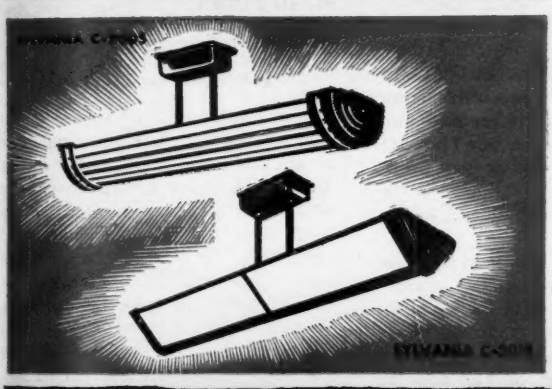

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These Sylvania Fixtures, which are ideal for stores, offices, laboratories and hospitals, now are equipped with 20-gauge steel reflectors finished with synthetic enamel. New design hinged end-caps and hinged diffusing panels make for easier and speedier maintenance. Supplied complete with four 40-watt Sylvania Fluorescent Lamps, Dua-Lamp Auxiliaries, and Starters — pretested and ready for immediate installation. Available with or without pendant.

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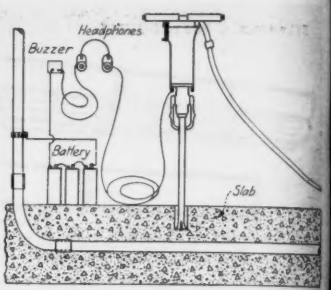
Practical Methods

[FROM PAGE 64]

of conductors and reinforcing rods and these were identified by paint marks on the floor. Yet with all the precaution taken the air-drill operator unwittingly strayed from his mark and drilled into a 2-inch conduit carrying power vital to plant operation.

By way of preventing a recurrence of the incident during subsequent drilling, the drill was equipped with a combination buzzer-telephone circuit that functioned perfectly by the simple expedient of connecting one side of the



HEAD PHONE and buzzer circuit detect drill contact with pipes to prevent puncture. Series circuit requires low resistance headset. High resistance set can be used with minor circuit changes.

battery circuit to any exposed conduit that was handy. The other end of the circuit was connected to the drilling machine as shown in the accompanying sketch. A generous section of lamp cord gave the operator unrestricted movement. In wearing the ear phones much of the drilling noise was excluded which tended to make the oscillating tone of the buzzer circuit easily heard whenever the drill deviated to strike the metal of the buried conduit runs. Needless to say, the device prevented any further puncturing of vital service carriers.

TEST BOARD FOR CORD PLUGS

MAINTENANCE

Safety is foremost in the minds of the management at Consolidated Vultee Aircraft Corporation's Fort Worth, Texas plant where the longest straight mechanized assembly lines in the world are in operation.

There are approximately 10,000 portable standard type electric drills in use throughout the assembly areas and every precaution is exercised to assure safe operation of these units. Each 110 volt, single-phase unit is equipped with a three-wire cord—the third conductor

Chicago Subway showing *Flur-o-guide* fluorescent units typical of those used throughout the system to provide safe, eye-easy illumination. Corning Flur-o-guide Alba Panels No. 90960 are used throughout.

Corning Glass Works does not manufacture or sell lighting fixtures. Complete units shown are obtainable from fixture manufacturers.

CORNING *Flur-o-guides*

PROVIDE ENGINEERED LIGHTING FOR CHICAGO SUBWAY

Illumination is one of the outstanding features of the new Chicago Subway. Fluorescent lighting is used with specially designed Corning *Flur-o-guide* light-diffusing panels. Working in conjunction with Corning, the subway engineers have provided illumination that is uniform, glareless, and easy on the eyes. The first such installation in the country, the system includes some 3000 totally enclosed fluorescent units equipped with 48-inch lamps. Approximately 1200 units with incandescent lamps are used for emergency lighting.

ENGINEERED LIGHTING PUTS LIGHT TO WORK

Corning *Flur-o-guides* permit the adaptation of light to the job it has to do. With the properly designed *Flur-o-guides*, developed to the best engineering principles by Corning Engineers, complete utilization of light is possible. For general illumination *Flur-o-guides* are available which give wide angle distribution of the light. Where a particularly high concentration of light is required in a given area, Corning provides a complete line of fresnel-type lens panels that concentrate the light where it is needed. They will be available in a wide range of styles and sizes for every fluorescent lighting application, when war demands slacken.

Write for "Corning Lighting Data," giving complete information on how you can apply engineered lighting to your illumination problems. Address Lighting Division, Dept. EC3, Corning Glass Works, Corning, N. Y.

"CORNING" is a registered trade-mark and indicates manufacture by Corning Glass Works, Corning, New York

ORNING *means* earch in Glass

Corning Engineered Lightingware

BRAND

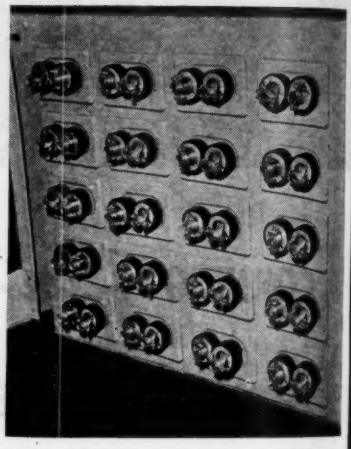
Practical Methods

[FROM PAGE 69]

providing the mechanical ground connection between the drill case and the receptacle outlet to protect the employee against injury should a drill become grounded.

To minimize the possibility of accidents, all bakelite cord plugs are now tested under four times their operating voltage at the electric drill section of the maintenance repair department — where about 485 drills are serviced each day. Such tests are made on all new plugs before they are placed on the spare parts stock shelves.

The test apparatus employed is simply a board containing a group of 20 flush mounted, duplex, three-prong receptacles connected to a 3-phase, 440-volt power supply through a circuit protective device and a magnetic switch



***HI-VOLTAGE TEST** on drill cord plugs singles out the weak and imperfect units which are discarded. After standing up under this 440-volt test, the plugs are placed in the spare parts stock.*

operated by a remote control button. Plugs are tested in batches of 40—taken right out of their cartons and plugged into the receptacles. The operator stands at the control button some distance from the board—just in case a plug should blow up—and turns on the juice. If the plugs are OK, nothing happens. If a plug happens to be shorted or has contact, insulation or other defects, the operator picks up the pieces.

With this precautionary test now enforced, drill repair employees know that plugs taken from the stock shelves are in A-1 condition and will not produce a hazard. And the crews using the drills rest easier because of this precautionary safety measure.

MOTOR SHOPS

PONY BRAKE TENSION DEVICE

Undoubtedly every motor repair shop in the country has encountered the need for some type of tension device to effectively band armatures. Many have developed their own methods, specifically designed for the problem at hand.

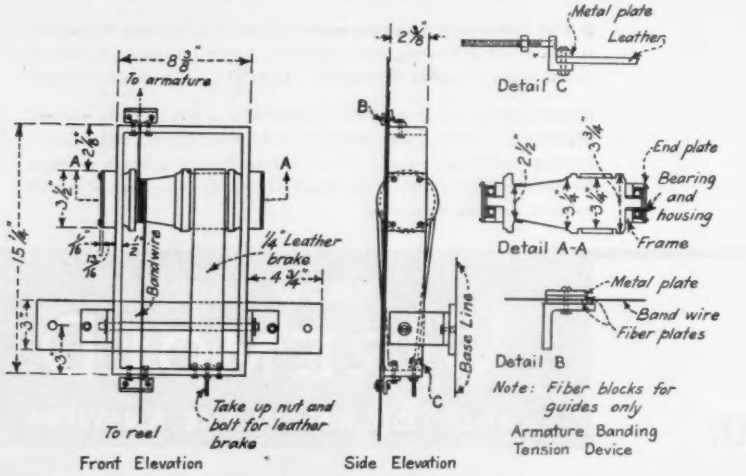
One method, the principle of which can be applied to both small and large armature work, is described in this item. This particular piece of equipment designed and built by Giles Armature & Electric Works, Marion, Ill., won third prize of $50 in the National Industrial Service Association Award Contest—a contest designed to produce and encourage the development and exchange of shop ideas that will effectively increase the efficiency and workmanship quality of the motor repair shops. It is outlined here through the courtesy of NISA.

The heart of the device is nothing more than a small tapered drum with a pony brake attachment. The drum is mounted in a 15¼-in. by 8⅜-in. rectangular steel frame which is pin-mounted to a base plate permitting it to "float" in a vertical plane (see attendant diagram—front elevation). The drum is divided into two sections: one-half provides the bearing surface for the leather tension belt; the other half, tapered from 3¼-inches to 2½-inches, is the spool around which several turns of banding wire is wound. The taper of the drum is important from the standpoint of the slippage it provides, permitting the banding wire "lead" and "take-off" (with respect to the drum) to remain in essentially the same position during the banding operation. If the drum had no taper the banding wire turns would tend to "creep" to the right causing friction tension at the guide plates and possible snarling of the drum turns.

There is no frictional heat developed in the banding wire. All tension is applied to the leather pony brake through a take-up bolt at the bottom of the rectangular frame (see diagram —detail C). The tapered drum rotates freely on ball bearing mounting (see diagram—detail A-A). The metal and fiber plate attachments (see diagram—detail B) at the top and bottom of the frame are not tension elements—they merely guide the banding wire on and off the tapered drum.

This compact attachment is mounted to a single base plate which can be bolted to the frame of a lathe or banding machine. After the banding operation is finished and the lathe is needed for other work, the device can be quickly removed by unfastening the two bolts in the base plate.

The principle employed in this tension device is being used for banding small high speed armatures manufactured for the aircraft industry.

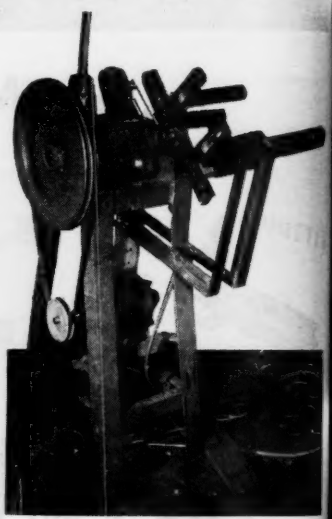


DETAILED SKETCH showing the design of the pony-brake type of armature banding tension device. Unit can be mounted to the frame of a lathe or banding machine.

AUTO TRANSMISSION OPERATES WINDING HEAD

Many motor shops that have a flair for building their own equipment find that old automobile transmissions offer a convenient means of obtaining the speed variation needed in winding equipment. Some have used single transmissions; others twin units coupled together to provide a greater speed range.

Such a single transmission unit is in use at the Payne Electric Co.,



WINDING MACHINE incorporates auto transmission and V-belt motor drive to obtain necessary speed range in this Houston motor service shop.

prominent Houston, Texas, electric motor service shop. Mounted on a supporting frame of 2½-in. angle iron, is a Plymouth transmission. To the driven shaft is fastened an "Ideal" coil winding head; to the driving shaft, a 15-inch V-belt sheave. Motive power is supplied by a ½ hp., 900 rpm., 3-phase, 220-volt motor equipped with a 5-inch, V-belt sheave and fastened to a floating base. Speed range obtained with this combination varies from 50 to 150 rpm. For winding heavy coils, a 1½-inch or 2-inch sheave is mounted to the motor shaft.

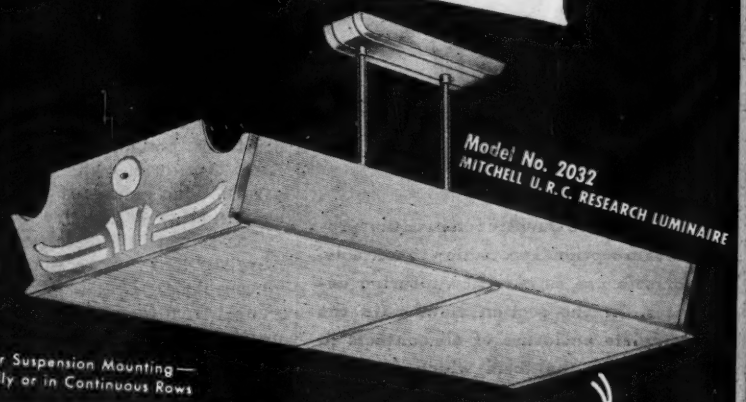
A revolution counter, belt driven by the winding head shaft, and an arm rest bracket with a fibre face for magnet wire guide completes the unit which is doing a first-class job.

2 TOP DEVELOPMENTS IN FLUORESCENT...TODAY

KOLD-VOLT COLD CATHODE *for Industrial Lighting*

U.R.C. RESEARCH LUMINAIRE *for Commercial Lighting*

Model No. 2081
MITCHELL KOLD-VOLT COLD CATHODE FLUORESCENT FIXTURE



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The *first* cold cathode fluorescent in a standard *"packaged"* unit! Gives you *instantaneous starting — average lamp life expectancy 10,000 hours — greatly reduced maintenance!* 4-light fixture—8 feet long overall—delivers a total of 8800 lumens of light. Each lamp unconditionally guaranteed for one year.

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MITCHELL FLUORESCENT

[FROM PAGE 72]

INFRA-RED AND STEAM OBVIATES A REWIND JOB

Washing the windings with a solvent, thoroughly flushing with clear steam, and drying with infra-red heat, recently salvaged the armature of a 1000 kw. rotary converter that had been slated for a rewind in a Westinghouse repair shop.

Close inspection revealed that the insulation had not blown to ground nor had the insulation even been burned. It was, however, saturated with grease, moisture and carbon absorbed from the atmosphere in which the converter had been operating.

Since the amount of copper and the length of time involved in a rewind would have been considerable it was decided that an attempt should be made to salvage the original windings. The first operation was to thoroughly wash and spray the windings with a solvent to remove the bulk of the grease and carbon. Clear steam, under light pressure (so as not to cut the insulation), was then used to flush out the core and windings and to dissolve any grease and dirt that had not been reached by the solvent.

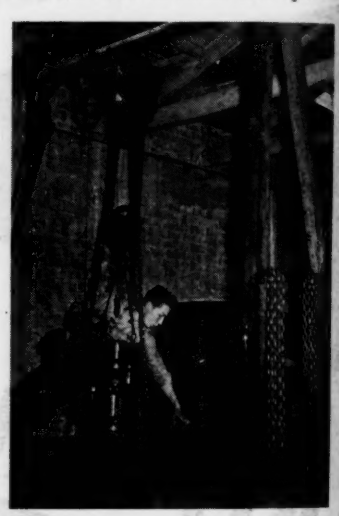
The windings were then thoroughly dried by portable infra-red lamps. After treatment with a thermoset varnish, the infra-red lamps were again used to set and dry the varnish.

The converter armature, which had megged "zero" on receipt, now read 20 megohms. Less than a week had elapsed from the time it had been dismantled until it was back in service again. Considerable time had been saved, and a sizable weight of new copper was not required at a time when copper was extremely critical.

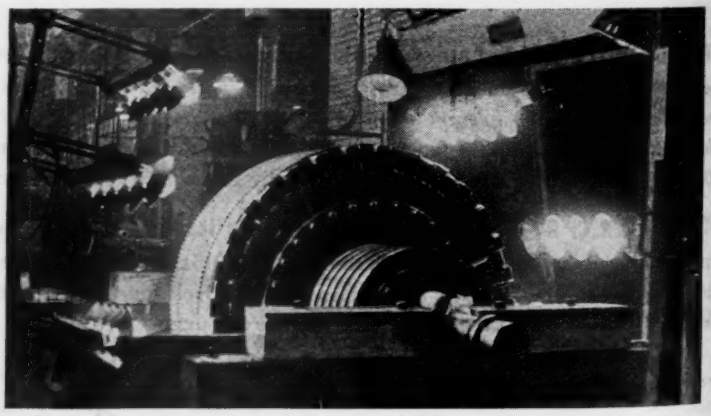
MOTORIZED CHAIN HOIST CUTS HANDLING TIME

There is no "shoemaker's children" condition existing in the shop of the San Antonio Armature Works, San Antonio, Texas. Wherever possible, H. S. Foster has an electric motor replace hand power, especially where it concerns the lifting or moving of heavy equipment. Latest of his motorization projects is the electrification of a chain hoist operating on a gantry over the truck loading aisle in the shop.

To accomplish the transformation, the original supporting casing on the 1½-ton chain hoist was discarded and a heavier and more roomy one was made to accommodate a chain sprocket drive attached to the sheave of the hoist and to provide mounting space for the ½-hp., 3-phase, 220-volt, 1750 rpm., motor complete with gear reducer. Through the gear reduction and chain drive the motor now operates



***MOTORIZED CHAIN HOIST** permits one man to do the work of two or three in this San Antonio motor service shop. Trolley support riding across gantry span provides added mobility to unit.*



***LARGE 1000 KW. ROTARY** converter armature whose windings were salvaged by the application of solvents and quick drying infra-red heat.*

Motor Shops

[FROM PAGE 74]

the hoist sheave at 75 rpm. One interesting feature is that this motor, before being rewound for its present duty, was a ¼-hp., split-phase, 110-volt, single-phase unit.

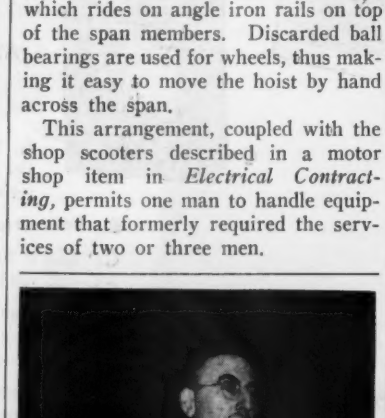
Floor control of the hoist motor is accomplished by rope handles which

REBUILT HOIST SUPPORT provides the necessary room for chain sprocket drive, gear-head motor (on right) and motor reversing switch with rope operated lever (on left).

operate a pivoted lever arm on a motor reversing switch mounted on the hoist frame opposite the motor.

Mobility across the gantry span is provided by a four-wheeled trolley which rides on angle iron rails on top of the span members. Discarded ball bearings are used for wheels, thus making it easy to move the hoist by hand across the span.

This arrangement, coupled with the shop scooters described in a motor shop item in *Electrical Contracting*, permits one man to handle equipment that formerly required the services of two or three men.



REGIONAL DIRECTOR, WPB, F. Peavy Heffelfinger, tells the N.C.E.I. War Conference that total war production needs prevents immediate release of materials for civilian requirements.

INDUSTRIAL ELECTRIFICATION

ENGINEERING • INSTALLATION • MAINTENANCE

Squirrel Cage Motor Starters—II

Specific types of starters both manual and magnetic, across-the-line and reduced voltage are discussed with particular reference to ratings and distinctive features.

THE first article on squirrel cage starters dealt primarily with the reasons for the development of the various types, and a comparison of the starting characteristics that may be expected. This second article will deal with each specific type of starter insofar as ratings and distinctive features are concerned. Regardless of manufacturer, the primary function of each specific type is the same. However, each manufacturer incorporates in its design various distinctive features that give a wide range of selection for the type which will best satisfy the user's application insofar as protection, ease of wiring, maintenance, reliability and safety are concerned.

Across-the-line Starters

Line-starters are obtainable in either manual or magnetic types, reversing or non-reversing, and in combination units with fusible or non-fusible motor circuit switches.

The smallest available starters are toggle type switches usually without overload protection and are rated up to 2 hp. at 110 to 600 volts. Motor protection is generally obtained, in instances where these switches are used, by thermal protectors imbedded in the motor windings.

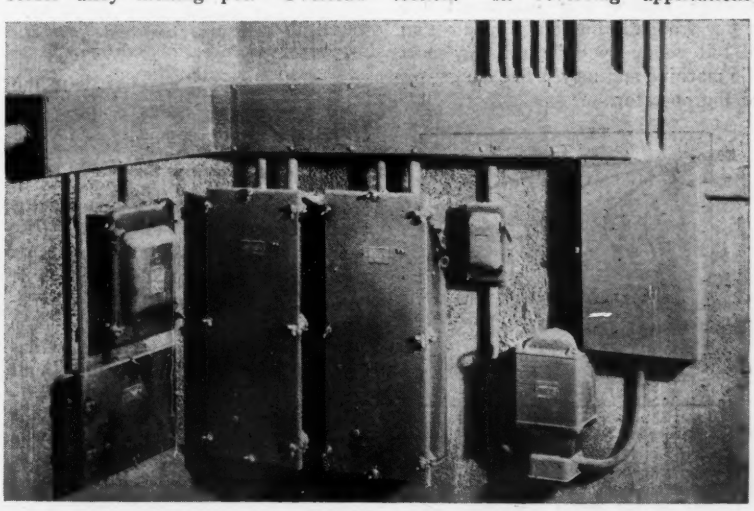
A manually operated starter with thermal overload protection and for reversing or non-reversing duty can be obtained in ratings up to 7½ hp., 25 to 60 cycles at 110 to 600 volts. It can also be supplied for two-speed control. Two standard units are installed in a single box to permit connection of windings in either parallel or series for two separate speeds. The units are interlocked to prevent simultaneous operation. During operation, if the thermal overload mechanism operates, the operating handle moves to a "tripped" position. It is then reset for starting by moving the handle to "off" and then "on". Thermal protection is generally provided by either a bimetallic strip or disc, or by a melting alloy type.

In the bimetallic type, the strip or disc will bend either slowly or by snap-action as heat is supplied by a resistance heater element in series with the motor circuit. This bending action will actuate a tripping lever (or open contacts in the magnet coil circuit of a magnetic switch) thus opening the motor circuit.

In the melting alloy type, the resistance heater element contains a ratchet wheel with its shaft imbedded in a solder alloy melting pot. Overload current passing through the heater element, melts the alloy so that the ratchet wheel is free to turn. This action permits a spring-latch to operate and disconnect the motor from the line.

Both types provide inverse time characteristics so that small harmless overloads will not operate the relay but either heavy sustained overloads or short circuits will operate the relay quickly and almost instantaneously.

For ratings up to 150 hp. at 220 to 550 volts, manual, multi-speed drum controllers can be obtained for two, three or four speeds, and for reversing or non-reversing service. The drum controller changes the winding connections so as to change the number of poles, thereby changing the motor speed. Standard additional equipment can be used to provide overload protection. In reversing applications



DUST-TIGHT STARTERS installed in a grain elevator. Two long switches in center are combination magnetic starters, for remote control of across-the-line starting.

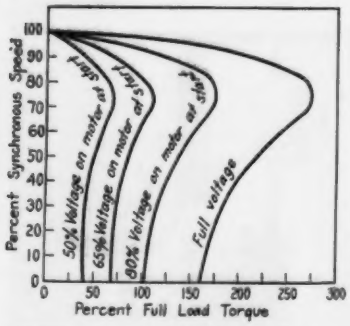
***DRUM CONTROLLER** used for across-the-line starting of a four-speed motor. Interlocked control compels operator to start motor on low speed.*

where plugging cannot be tolerated, anti-plugging relays may be used in conjunction with the controller. For the larger horsepower ratings, the drum controller merely acts as a set-up switch while separate contactors, controlled magnetically, make-and-break the motor circuit.

Magnetic Line-starters

The magnetic line-starter has the broadest application since it provides remote control for use with pushbuttons, pressure switches, float and limit switches and other pilot devices and in addition gives complete protection, including overload and either low voltage release or low voltage protection.

Low voltage release is provided when a two-wire pushbutton or pilot device circuit is used. Low voltage or voltage failure will disconnect the motor from the line but a resumption of full voltage will immediately start the machine and may prove dangerous to the operator.



***TORQUE DEVELOPED** by the motor varies as the square of the applied voltage to the motor terminals. The curves show graphically how the torque is reduced as additional resistance is introduced into the starting circuit.*

Low voltage protection is provided by a three-wire pilot device whereby low voltage will disconnect the motor from the line permanently and reclosure of the breaker will not take place until the start button is pressed.

Overload protection is provided in most cases by either a bimetallic or melting pot type thermal relay.

Standard starters can be obtained in this type for non-reversing duty in ratings ranging up to 750 hp., 110 to 600 volts with any type enclosure required.

For application in explosive or corrosive atmospheres such as refineries, chemical plants, paper and cement mills, etc., an oil-immersed across-the-line starter is available in ratings of 5 to 100 hp., at 208 to 600 volts. This starter is magnetic, may be used with

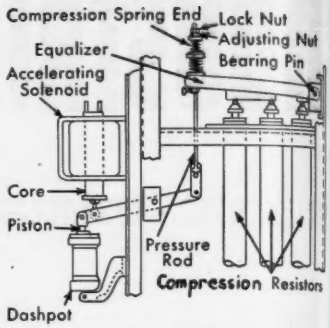
***THREE COMPENSATORS** equipped with oil-immersed contacts to protect against oxidation and erosion from acid fumes. Two outside units are 50 hp. automatic autostarters and center unit is 75 hp. manual compensator.*

pilot devices and is provided with the same complete protection as those described above.

Combination Starters

Combination across-the-line starters are provided with both a magnetic operating line contactor and a motor circuit switch or breaker in the same box. This combination allows a reduction in installation cost, saves space and makes a more attractive installation. Generally, either a motor circuit switch with fuses, or a non-fusible circuit breaker can be obtained. Thus complete circuit protection is provided by this one unit against short-circuit, single phasing, overload and low voltage.

Ratings are available up to 200 hp., at 110 to 600 volts, for either reversing

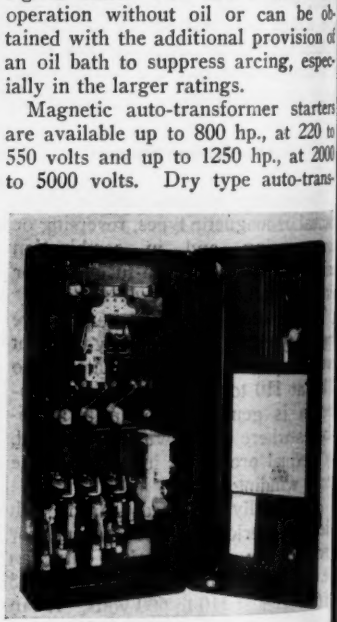


***ACCELERATING SOLENOID,** dash pot, pressure rod, and equalizer bar arrangement on a compression resistor starter. As the pressure on the column of resistance discs is increased, the total effective resistance is reduced. Since this gradual reduction of resistance is stepless, smooth motor acceleration is obtained.*

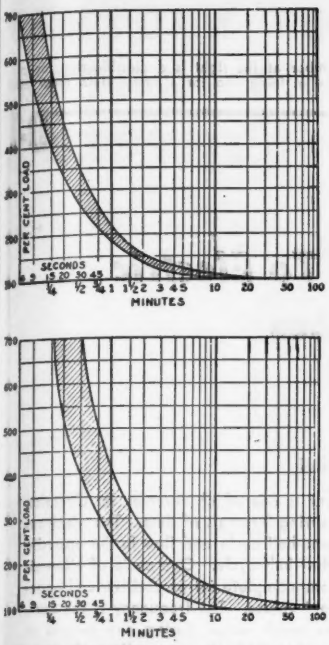
or non-reversing duty. In the higher voltage starters, a built-in control circuit two-winding transformer is furnished to operate the control circuits at low voltage.

Manual auto-starters are available up to 200 hp., at 220, 440, 550 and 2200 volts. Starting is performed by throwing the single operating handle in one direction for starting and in the reverse direction for running where it is held magnetically for overload and low voltage protection. An interlocked starting sequence prevents starting in the "run" position. Starters are designed either with arc barriers for operation without oil or can be obtained with the additional provision of an oil bath to suppress arcing, especially in the larger ratings.

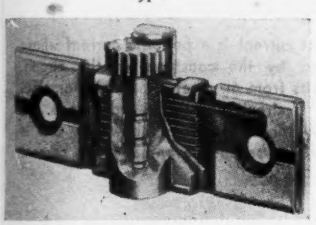
Magnetic auto-transformer starters are available up to 800 hp., at 220 to 550 volts and up to 1250 hp., at 2000 to 5000 volts. Dry type auto-trans-



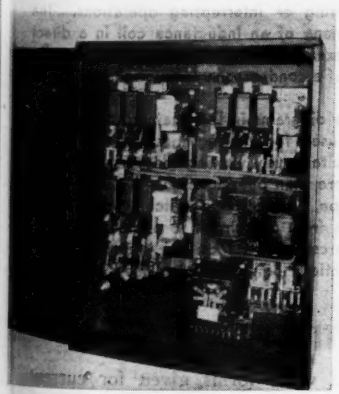
***COMBINATION** line-starter consisting of a non-fusible line breaker and a magnetic breaker to connect motor terminals to the line for starting and running. Bimetal thermal overload and low voltage protection is provided for these units.*



ABOVE CURVES show the comparison of tripping characteristics of thermal overload relays used in one electrical manufacturers line of breakers. The upper curve is for the melting alloy type and the lower for the bimetallic type.



CUTAWAY VIEW showing a melting alloy type of thermal overload device. Overload currents in the heater element melt the solder in the pot permitting the ratchet to turn and set the tripping action in motion.



MAGNETIC AUTO-TRANSFORMER starter. Dry type transformer construction is used with taps brought out for 50, 65 and 80 percent full line voltage. Time limit accelerating relay assures a definite-time acceleration period. Relay is motor operated and can be adjusted for 2 to 30 second operation.

formers are standard, but oil immersed may be supplied for use in explosive or corrosive atmospheres. Time limit acceleration is provided by an adjustable relay which can usually be set to operate at from two to 30 seconds for magnetic control of the starting and running contactors. Low voltage release or protection and overload protection by thermal relays is provided as in the case of other starters already described.

Ratings

Ratings of manual starters run up to 250 hp., at 220 to 600 volts while magnetic starters range to 500 hp., at 208 to 600 volts.

Drum controllers for use with fixed resistance units are obtainable with multi-point control in ratings up to 30 hp., at 220 to 550 volts.

Magnetic fixed-resistance starters range up to 250 hp. for two point acceleration and up to 400 hp. for three point acceleration. The same type and degree of protection is provided with these starters as with others previously described. For more points of acceleration standard starters are not available, but starting equipment can be obtained to meet practically any restriction imposed by the power supply facilities and the torque requirements of the load.

In summarizing on reduced voltage starters, it will be found that auto-transformer starters find their widest application among drives with larger horsepower ratings. Below 30 or 40 hp., resistance starters generally prove more satisfactory and economical for most applications.

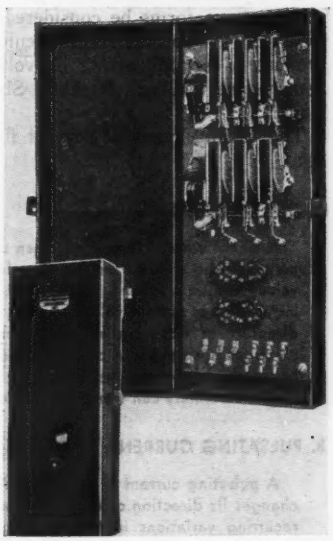
Line current, for the same voltage at the motor terminals and consequently for the same developed starting torque, is considerably greater for the primary resistor type starter. However, power factor during the starting interval is much better with the resistance unit.

Since the voltage applied to the motor terminals remains the same for an auto-transformer start, and since the torque varies directly as the square of the voltage, the torque during the starting interval remains almost constant. With the resistance starter, the motor terminal voltage increases with the speed and consequently the torque also increases providing a faster and smoother acceleration.

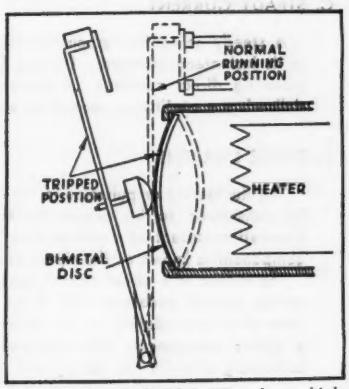
For any particular installation where both types of reduced voltage starter may be considered, the resistor type is generally found to be the cheaper, but the auto-transformer starter has the higher efficiency.

Maintenance, reliability, safety and ease of control are about the same with both types.

ACROSS-THE-LINE magnetic starter and safety switch are mounted directly on planer so that the machine (which is often moved), motor and control can be moved as a unit.



SELECTIVE TYPE controlled for a two speed separate winding motor. This across-the-line magnetic breaker permits the operator to select the operating speed from a remote control station.



THERMAL OVERLOAD relay which uses a bimetallic disc for operation. Overload condition increases the heater current which heats up the disc and causes it to snap out tripping the breaker off the line.

DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

D-1

Terms and Definitions Applicable To Electric Circuits and Electronic Tubes

1. CURRENT FLOW

To fully understand and utilize electronic apparatus it is very essential that the input and output current or voltage wave forms be considered. The most common types of wave form and the circuit elements essential to produce a certain current or voltage wave form phenomena are tabulated on Data Sheet D-2 for resistive loads.

The various types of current flow may be described as:

A. DIRECT CURRENT

A direct current is defined as an unidirectional current. It may also be defined as one in which the average current value is always above zero in one certain direction. The instantaneous current value may vary with time, but not in the direction of flow. In a direct current circuit, the flow of electrons is always in a definite direction. Direct current can be produced by d.c. generators or chemical cells and batteries. Rectifiers can transform alternating into direct current

B. PULSATING CURRENT

A pulsating current is a form of direct current which never changes its direction of electron flow, but which has regularly recurring variations in the magnitude of the instantaneous current value. The output of a half or full wave rectifier is a good example of this type of current flow. The wave form may be sine, square, rectangular, triangular, or elliptical in shape.

C. STEADY CURRENT

A steady or continuous current is one which never varies in its instantaneous values. (It may be thought of as a non-pulsating direct current.) A battery or cell is capable of delivering a continuous current to a circuit.

D. RIPPLE CURRENT

The fluctuation or pulsation in the output of a rectifier can be considered to be caused by the superimposing of an alternating current on a steady direct current. The alternating component is known as the ripple current.

The output of a direct current generator (which is an alternating current generator with a mechanical rectifier in the form of a commutator) or an electronic rectifier usually has a ripple component. The resultant output wave form is something between the steady and pulsating wave forms.

E. ALTERNATING CURRENT

An alternating current is one which reverses its direction of flow at regularly recurring intervals of time. The electrons flow one direction for one-half cycle and flow in the opposite direction during the other half cycle. One cycle of alternating current consists of one complete set of positive and negative instantaneous current values. The frequency is the number of complete cycles which occur during one second of time. Unless otherwise specified, the term alternating current usually applies to a current flow which is equal in each direction or has positive and negative current wave shapes which are the same. An alternating current generator or an electronic oscillator can produce alternating current.

F. OSCILLATING TRANSIENT CURRENT

An oscillatory transient current is a periodic current whose frequency is determined by the constants of the circuit. This current usually results from an electro-magnetic or electrostatic disturbance in a circuit containing inductance and capacitance. The oscillatory wave form shown in D-2 is known as a damped wave, because eventually the current decays to zero.

G. TRANSIENT CURRENT

A transient current is usually the result of a switching operation in a circuit which contains inductance or capacitance. The transient current results from an electro-magnetic or electro-static disturbance and differs from the oscillating current in that it is not self-sustaining or repetitive except by further circuit closing or interrupting operations. The current decay phenomena of an inductance coil in a direct current circuit is an example of transient current. The discharge characteristic of a condenser in a direct current circuit is another.

It is noted from the diagrams in D-2 that the cathode-ray oscilloscope may be used for viewing most of the various wave forms. For simultaneously viewing the current or voltage phenomena of more than one circuit on the screen of a cathode-ray oscilloscope, an electronic switching device may be employed to switch from one circuit to another with such rapidity that the fluorescent trace on the screen for each wave does not substantially diminish during the switching.

2. ELECTRO-MOTIVE-FORCE

The definitions and wave forms given for current flow apply in general to the direction and magnitude of the voltages which produce these currents.

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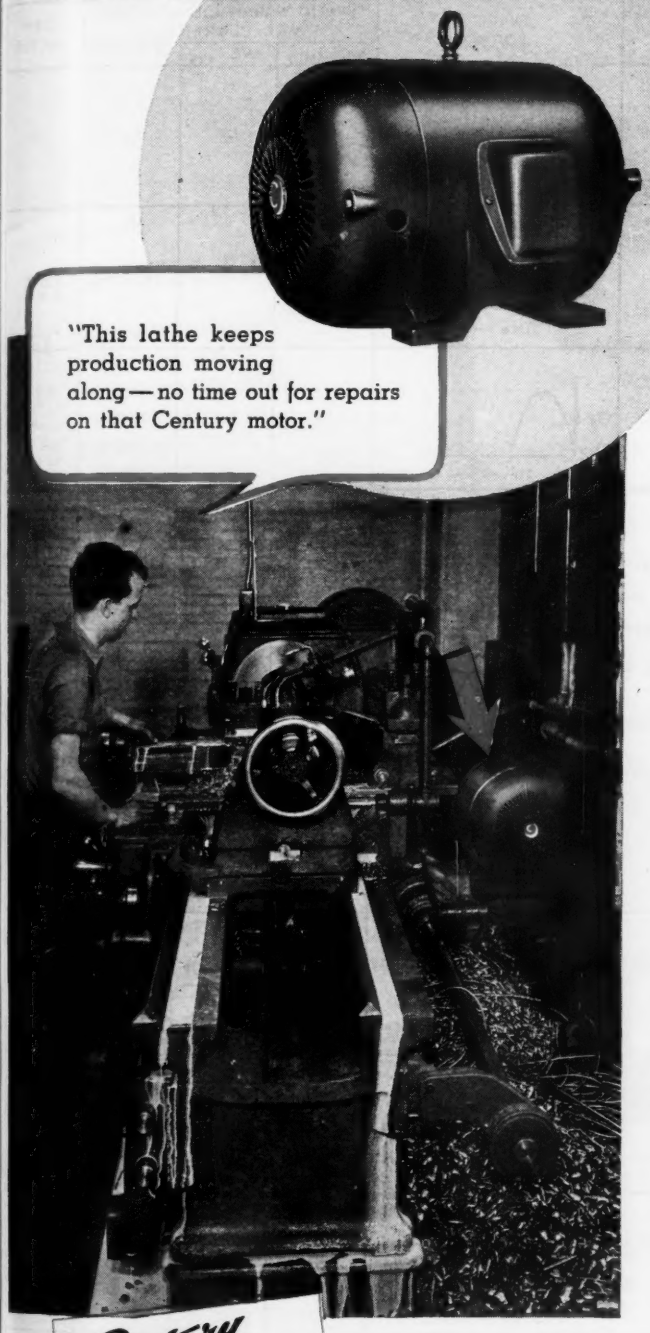

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DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

D-2

Types of Current Flow

TYPE OF CURRENT FLOW			CIRCUIT ELEMENTS	WAVE FORM	CURRENT MAGNITUDE IN TERMS OF MAX. CURRENT-I_m			FORM FACTOR
					MIN-$I_{MIN.}$	AVE-$I_{AVE.}$	R.M.S.-I	
DIRECT	Steady		Battery, Res., Cathode-ray oscilloscope	I_m, Time	I_m	I_m	I_m	1.00
	Ripple (A.C. Component)		D-C Gen., Res., C.R.O.	Ripple current, I_{min}, I_m, Time	0.65 I_m (Assumed)	0.88 I_m	0.89 I_m	1.01
	PULSATING	Half Wave 1 Phase	1φ Rect., 1 phase A-C Gen., Res., C.R.O.	I_m, π, 2π, Time	0	0.318 I_m	0.50 I_m	1.57
		Full Wave 1 Phase	1φ Rect., 1 phase A-C Gen., Res., C.R.O.	I_m, π, 2π, Time	0	0.637 I_m	0.707 I_m	1.11
		Full Wave 3 Phase	3φ Rect., 3 phase A-C Gen., Res., C.R.O.	I_m, π, 2π, Time	0.87 I_m	0.955 I_m	0.975 I_m	1.02
ALTERNATING	Single Phase		1 phase A-C Gen., Res., C.R.O	I_m, π, 2π, Time	$-I_m$	0.637 I_m for half cycle / 0 for 1 cycle	0.707 I_m	1.11
	Three Phase		Aφ, Bφ, Cφ Res., 3 phase A-C Gen.	A, B, C, I_m, $\frac{1}{2}I_m$, π, 3½, 2π, Time	$-I_m$	For 1 Phase 0.637 I_m for ½ cycle / 0 for 1 cycle	For 1 Phase 0.707 I_m	For 1 Phase 1.11
TRANSIENT	Oscillatory		C, L, Battery, Sw., Res., Discharged when switch is closed, C.R.O	Time (Damped Sine Wave)	—	—	—	—
	Inductive		L, Battery, Sw., Res., Discharged when switch is closed, C.R.O.	Charge, Discharge, Time	—	—	—	—
	Capacitive		C, Battery, Sw., Res., Discharged when switch is closed, C.R.O	Charge, Discharge, Time	—	—	—	—

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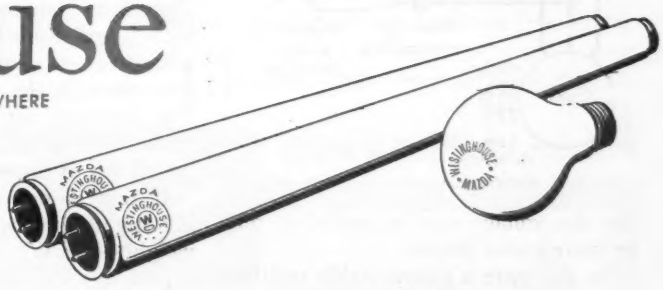

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QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay $5.00.

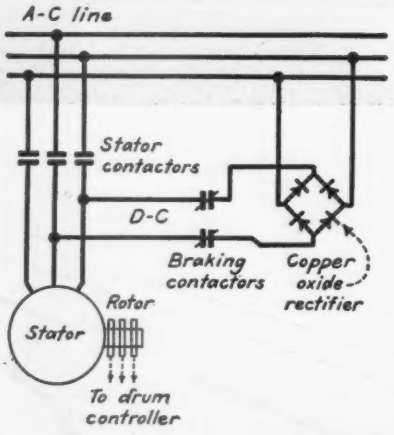
READER'S QUIZ

DYNAMIC BRAKING

QUESTION 138. Since we increased the size of the lift magnet on one of our cranes it is very difficult to control the lowering operation owing to the increased weight. On lowering, the motor runs faster on the first step than when the controller is full on. The hoist motor is a 3-phase, 440-volt, 60-cycle, slip ring type with a drum controller. Is there some way to check the speed of this motor similar to the dynamic braking used on d.c. motors? The hoisting operation works satisfactorily.—J.L.

A. TO QUESTION 138. You can use dynamic braking on your wound rotor motor. You will have to install a magnetic contactor so that the magnetic switch closes on the first step of the drum controller. This will also enable you to incorporate the braking contactors and copper-oxide rectifier as shown on diagram.

Referring to diagram you will notice that when starter contacts are opened,



the d.c. voltage can be applied to one or more stator phases.

In this case a copper-oxide rectifier is used, which makes a very compact and economical method of supplying correct d.c. voltage. However, an external d.c. can be supplied from a d.c. bus or other source.

You will have to use interlocking contactors so that the starter and d.c. contactors cannot be closed at the same time; also, a timing relay is required to open the braking contactors as soon as the motor is stopped.

Owing to the fact that a.c. motor windings have a low resistance, external resistors would have to be used to limit the braking current when 125 volt d.c. supply is used.

As a rule, satisfactory braking can be obtained with a current from two to three times the full-load rated amperes of the motor, and the voltage required will depend on the resistance of the motor winding.

Approximate values of the resistance, for medium sized motors, are obtained by the following formula:

$$R = \frac{100 \times \text{full-load amperes}}{6 \times \text{a.c. voltage}}$$

Where R = ohmic resistance between two motor leads. The d.c. supply voltage can then be determined by multiplying this approximate resistance value by the desired or required braking current.—R.J.P.

A. TO QUESTION 138. In order to provide dynamic braking for your crane it would be necessary to have a source of direct current available. It would require a direct current generator capable of delivering 150 to 200 percent of the load current, at perhaps 24 to 40 volts.

Connections should be made so that in the lowering position, the regular alternating source would be disconnected, and the direct current source connected, to allow direct current to flow through the stationary winding. The braking action would be controlled by varying the resistance in the circuit of the wound rotor.

If this is not possible, you might investigate the possibility of a counterweight.—J.E.W.

A. TO QUESTION 138. Since you do not have dynamic braking in your present circuit, your crane should, at the present time, have a mechanical load brake in its hoisting mechanism. The function of the load brake is to hold the load while the motor is at rest and to hold the load down to motor speed while the load is being lowered. In my opinion, an inspection of the mechanical load brake will reveal the true cause of your troubles and will make the installation of dynamic braking (with its associated expense) unnecessary. To check the load brake, release the the magnetic brake on your motor, and if the load starts to lower, your load brake is not functioning properly. Most load brakes are designed to hold 150 percent of the rated capacity of the hoisting mechanism. Also check the weight of your new magnet against the capacity of your crane.—R.E.

A. TO QUESTION 138. The overhauling motor on the lowering of the crane magnet may be corrected by adding additional resistance in the first lowering point. If this still does not hold the speed down, more resistance on the first point of the hoist position can be used to give a reverse torque on lowering by putting the drum in hoist position. The amount of resistance in either case will depend on the rating and characteristics of the motor and on the actual load to be handled.—L.R.B.

FUSE PROTECTION

QUESTION 139. In cases of emergency would the same protection be attained by using two fuse links, paired together in the same holder, as using a single fuse link of the correct size? For instance, a 10 and 15 amp. link used in place of a 25 amp. link.—J.A.H.

A. TO QUESTION 139. The following are some of the objections to the use of two links: 1. There is no assurance that the current will divide between the two links in proportion to their rating. As a result one link would blow before the

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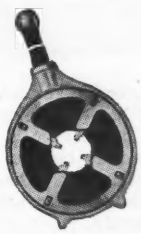

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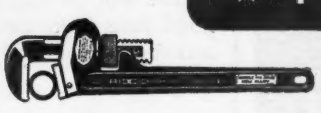

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other was carrying its full current, and of course the second link would blow immediately following the first link.

2. The links are calibrated on the basis of a single link in a holder. If there is a second link in a holder which is also generating heat, it will raise the ambient temperature within the holder above that for which either link was calibrated, and for this reason the pair would blow at a value of current somewhat below the sum of the two ratings.

3. When placed side-by-side, part of the restricted portion of one link might overlap the enlarged portion of the other link, thus affording a heat leakage path for the first link which would be greater than that provided by its own enlarged sections. This again would affect its rating by an indeterminate amount.

4. It is so easy to forget to replace the two links with the proper link when it becomes available.

A renewable fuse would seem to be an ideal device for the maintenance department because of its convenience and economy of replacement. In practice, however, its utility is often abused. —G.I.S.

A. TO QUESTION 139. In "cases of emergency much is done that should not be tolerated under ordinary conditions. One might ask, "Just what is a case of emergency?" This is the responsibility entrusted to the judgment of the operator who makes the decision of the moment.

The reader's question can be answered briefly by "no"! The "same" protection could not be expected by two parallel fuse links in the same or separate cartridges. For a detailed and able discussion of this subject refer to the literature of leading fuse manufacturers.

In a few words, omitting details, the protective function of a fuse depends upon the balance between the heat generated in the fuse by the current and the heat removed through the surrounding media. Any alteration of the dimensions or arrangement of the parts of the fuse (and its clips) will affect this balance. The use of two parallel links may result in unnecessary "blows" and generally uncertain operation. Extreme conditions might contribute to burring and rupture of the case.

The practice of doubling fuse links because of negligence or ignorance is all too common. A few minutes devoted to study of what happens inside a fuse will persuade one to insist on good fuse links properly installed in sound cases and in fuse clips which fit. —H.A.E.

A. TO QUESTION 139. The answer to this question is no. The

current through each fuse most likely will not be in proportion to its ampere rating. The resistance of two fuses of the same current carrying capacities made by two different manufacturers may be very different when figured in percent. Typical values would be .002 Ω for the 15 amp. fuse, .004 Ω for the 10 amp fuse. If worked out by ohms law the following values will be obtained: Full load current is equal to I which is equal to 25 amperes. The equivalent resistance is equal to $\frac{R_1R_2}{R_1+R_2}$

Thus $R_{eq.} = \frac{.002 \times .004}{.002 + .004} = .001333$ ohms; and the voltage drop across the fuse links is $E = I\ R_{eq.} = 25 \times .001333 = .0333$ volts.

From ohms law then, the current through the 15 amp. fuse link would be $I_1 = \frac{E}{R_1} = \frac{.0333}{.002} = 16.66$ amps; and through the 10 amp. link, $I_2 = \frac{E}{R_2} = \frac{.0333}{.004} = 8.33$ amps.

The current flowing through each fuse is in proportion to the resistance of the fuses not the ampere rating. Theoretically, in this case the 15 ampere fuse will blow first, then the 10 amp. right after it.—F.S.C.

A. TO QUESTION 139. Yes, in an emergency you would get essentially the same protection. However, it is not desirable and a poor habit to get into. Electricians are apt to exceed the cartridge rating by doubling up links. A test in free air will prove that a 30 amp. link will blow at about 34 amperes; if for instance a 10 ampere link is connected in parallel with it, it will blow at approximately 45 amperes.—E.J.K.

A. TO QUESTION 139. Fuses in parallel will give the same protection as a single fuse but one important fact must be borne in mind. All the fuses to be parallelled must have the same ampere rating. The reason for this precaution is based upon fundamental laws of electricity. Conductors of *equal* resistance in parallel will share the current equally. Since the resistance of a fuse is negligible it stands to reason that in a given circuit the current through any one fuse of a group of parallel fuses will be equal to the total current divided by the number of fuses. This may be expressed as an equation; current in one fuse $= \frac{\text{total current}}{\text{number of fuses}}$

If a 10 ampere fuse and a 15 ampere fuse were to be placed in parallel in a 25 ampere circuit both fuses would blow out even though the sum of their ratings equals 25 amperes. This hap-

pened because each fuse carried half the load which is 12½ amperes. The 10 ampere fuse cannot carry the 12½ ampere load for any length of time and eventually blows out. This then throws the entire load of 25 amperes upon the 15 ampere fuse which also blows because of the overload on it.

In a situation like this it would be necessary to have two fuse links of equal ratings. Two 15 ampere fuses would be the nearest commercial sizes available and should be used. The combined rating would be 30 amperes which would still give ample protection in an emergency.—G.B.

CURRENT TRANSFORMERS

QUESTION 140. On a recent construction job I have installed several current transformers of a new design which consists of a coil of wire which is installed by slipping over one of the conductors to be metered. The conductor itself acts as the primary or core of the transformer; this coil as the secondary. Now as everyone knows the old fashioned conventional type current transformer, if open circuited under load, would build up a very high potential on the secondary winding causing damage to the transformer itself, which is also hazardous from a safety angle. Would this condition occur with the new type of transformer which I have described above?—D.E.O.

A. TO QUESTION 140. Judging from the outside appearance, some current transformers appear to be a coil of copper through which the primary is threaded. The internal structure, however, is not fundamentally different from the type having an exposed core. That is, there is still the iron core magnetic circuit around the primary conductor, and the secondary is a coil of appropriate number of turns around one leg of the core. Sometimes the secondary is divided into two coils, one around each of the legs of the core to make the whole unit symmetrical.

Large currents in the primary will charge the core with considerable flux unless there is sufficient current in the secondary to set up an opposing flux. If the secondary circuit is open so that no secondary current can flow, the primary flux will be unopposed. The primary flux produced by large primary currents in such a case will generate a high voltage in the secondary winding which would be hazardous.—G.I.S.

A. TO QUESTION 140. In regard to whether or not a dangerously high voltage will be induced in the coil of the current transformer mentioned, I would say that there definitely would be a high induced voltage. When the coil is slipped over the conductor we have essentially a transformer with a primary of one turn, and a secondary having many turns which is, of course, the coil. The ratio of the transformer would then be 1 to (the number of turns in the secondary coil). Therefore, if the coil had 1000 turns, the ratio would then be 1 to 1000, and from this it is clear that a high voltage would be induced if the secondary were left open. (The number of turns here was assumed, so for various coils the ratio would be different.) If the voltage induced by one turn was say 5 volts on primary, a coil of 1000 turns would have an induced voltage of 5000 volts.—C.E.B.

A. TO QUESTION 140. The reader is wise to anticipate the hazard of high potential on the open secondary of the current transformer. The secondary circuit of any current transformer should be kept closed to avoid this hazard to equipment and personnel. A more complete discussion of the question would include mention of the differences between the types of transformers mentioned and consideration of the possibility of high potentials in the secondaries.

The high potential which appears on the secondary of any current transpurpose of the windings which are former is a natural consequence of the designed to produce a current proportional to the primary current regardless of the impedance in the secondary circuit (within practical limits). An open secondary may be considered as an extremely high impedance and the potential rises to a value limited only by the characteristics of the magnetic circuit.

In general, current transformers can and should be connected in the secondary circuit completely before connections are made in the primary. This order of procedure is usually most convenient and always safer. Most portable current transformers have a short circuiting switch at the secondary terminals which may be kept closed at all times except when the meter is in actual use. In any case it should be shorted whenever work is done on the circuits whether "hot" or not. When such devices are built into the transformer it is reasonable to assume that they should be used whenever there is a possibility of opening the circuit. Types which have special protective devices and some types intended only for permanent switchgear installation

may not have shortcircuiting switches, but the absence of such a switch is not necessarily an indication that a protective device is included.

It is safe to "short out" the secondary of the current transformer circuit before disconnecting any part of the secondary circuit. A convenient device is a short flexible wire equipped with test clips which may be snapped quickly over the terminals on the current transformer side of the circuit to be opened. Some electricians who service switchgear carry a jumper made up of three or four pigtails each with an insulated test clip and all spliced together at their common end. It is sometimes possible to ground the secondary as well as short circuit it, which can be done conveniently with four clips on a three phase system. Care should be exercised to be sure that the proper terminals are selected for shorting.—H.A.E.

A. TO QUESTION 140. From the description of the new type current transformer used by D.E.O. I would say it was a window type current transformer.

This type current transformer is described on page 596—Sec. 6—Par. 172 in the 1941 edition of The Standard Handbook for Electrical Engineers. It must be handled in the same manner as any other type current transformer.

When the secondary of the window type current transformer is opened under load all the current in the primary becomes magnetizing current, and a high voltage is induced in the secondary winding. The same thing will happen in other type current transformers.—G. W. L.

A. TO QUESTION 140. This current transformer is of the through type and has been in use for many years. It consists of a core and secondary winding. The line conductor forms the primary winding.

Since the principle of this type is exactly the same as the busbar type of current transformer, the same precautions must be observed. If the secondary circuit is open while the transformer is in operation, there will be no secondary demagnetizing effect and the primary currents being fixed by the line load will cause the flux to rise to a high value, will increase the iron losses and build up the secondary voltage to a considerable extent. This will create undue heat and if the transformer doesn't burn out it will probably be ruined for any future use.—S.S.P.

A. TO QUESTION 140. The primary conductor acts as the primary winding but not the core. This type (through type) of transformer invariably has an iron core. In laboratory work, an air core type may be set up, but only for experimental purposes.

The same precautions must be taken with the type mentioned in the question, as with any other type current transformer.

When the secondary circuit of a current transformer is opened and the primary is carrying current, there is no demagnetizing effect of the secondary ampere turns. The mutual flux increases and due to the large flux, which is limited only by saturation, the induced voltage of the secondary may become great enough to endanger life or puncture the insulation. For this reason the secondary winding of a current transformer should never be opened if the primary is carrying current.—F.G.

Can you ANSWER these QUESTIONS

QUESTION G6—What size condenser would you put on a telephone receiver circuit to take the a.c. ripple out; using a 4-volt battery and a bulb trickle charger?—W. L. C.

QUESTION H6—We have three 2,400, 240 volt 150 kva. capacity transformers with single phase windings which we wish to connect in a symmetrical bank to a three-phase line of the above indicated voltage. These transformers lack polarity markings. Therefore, will some reader volunteer information on how best to proceed in the manner of testing for the secondary voltages on a step by step basis with only a voltmeter available?—P. C. Z.

QUESTION J6—We would like to use a pilot light to indicate that our 110-volt magnet is on. I connected a 110-volt, 25 watt lamp on the load side of a two pole switch. When the switch was pulled, the lamp flared up and went out. I would like to know what caused the lamp to burn out and what to do to correct this trouble?—R. E. P.

QUESTION K6—We have been connecting up a 117-volt, a.c. lighting switchboard and would like to know from where the ammeter reading for phase B is obtained. The connections at the bus bars are like this: phase A has a current transformer for its ammeter reading, phase C has the same. But there are no transformer connections that enable you to get a reading on phase B. Yet the selector switch on the front of the board selects a reading for each phase on the ammeter.—R. F. K.

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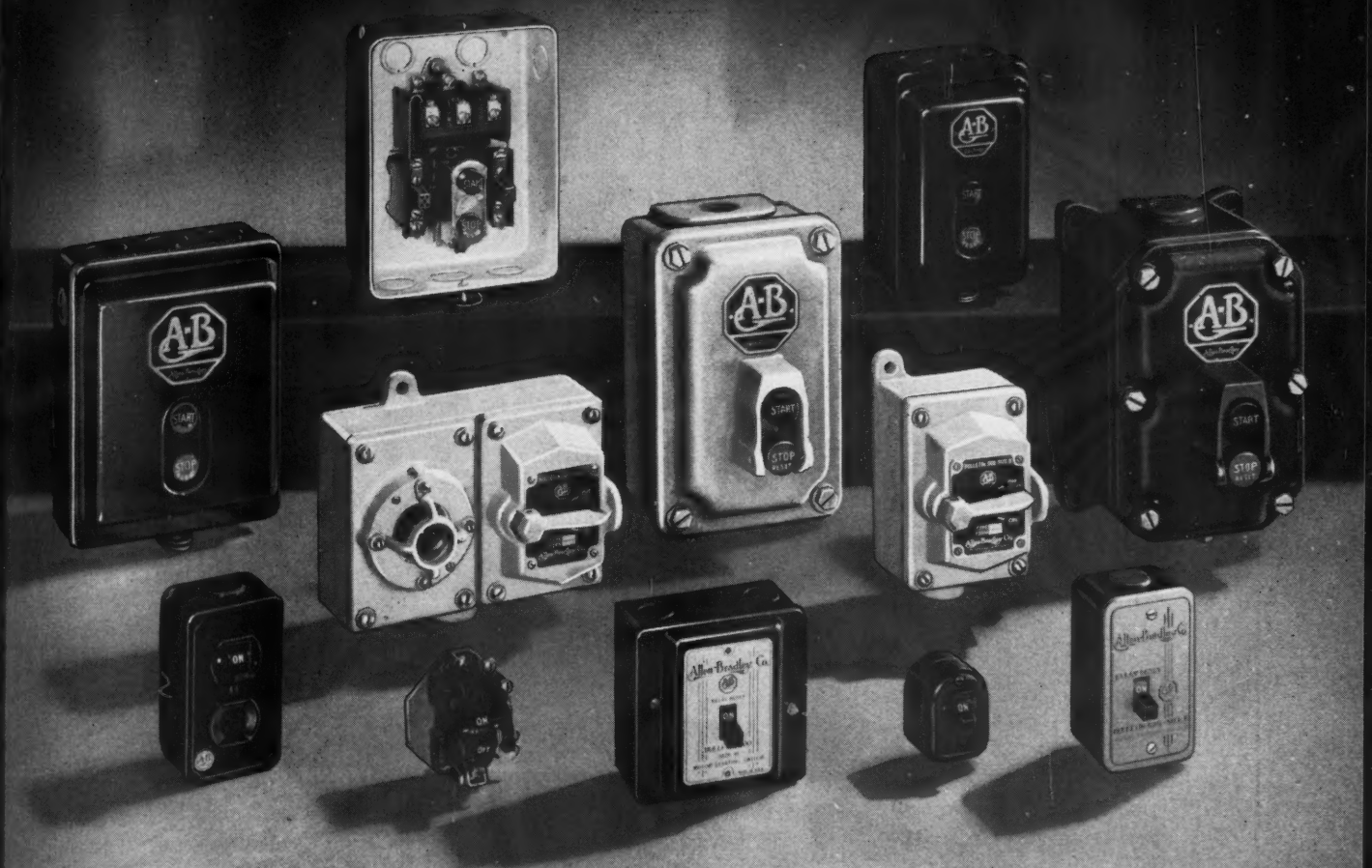

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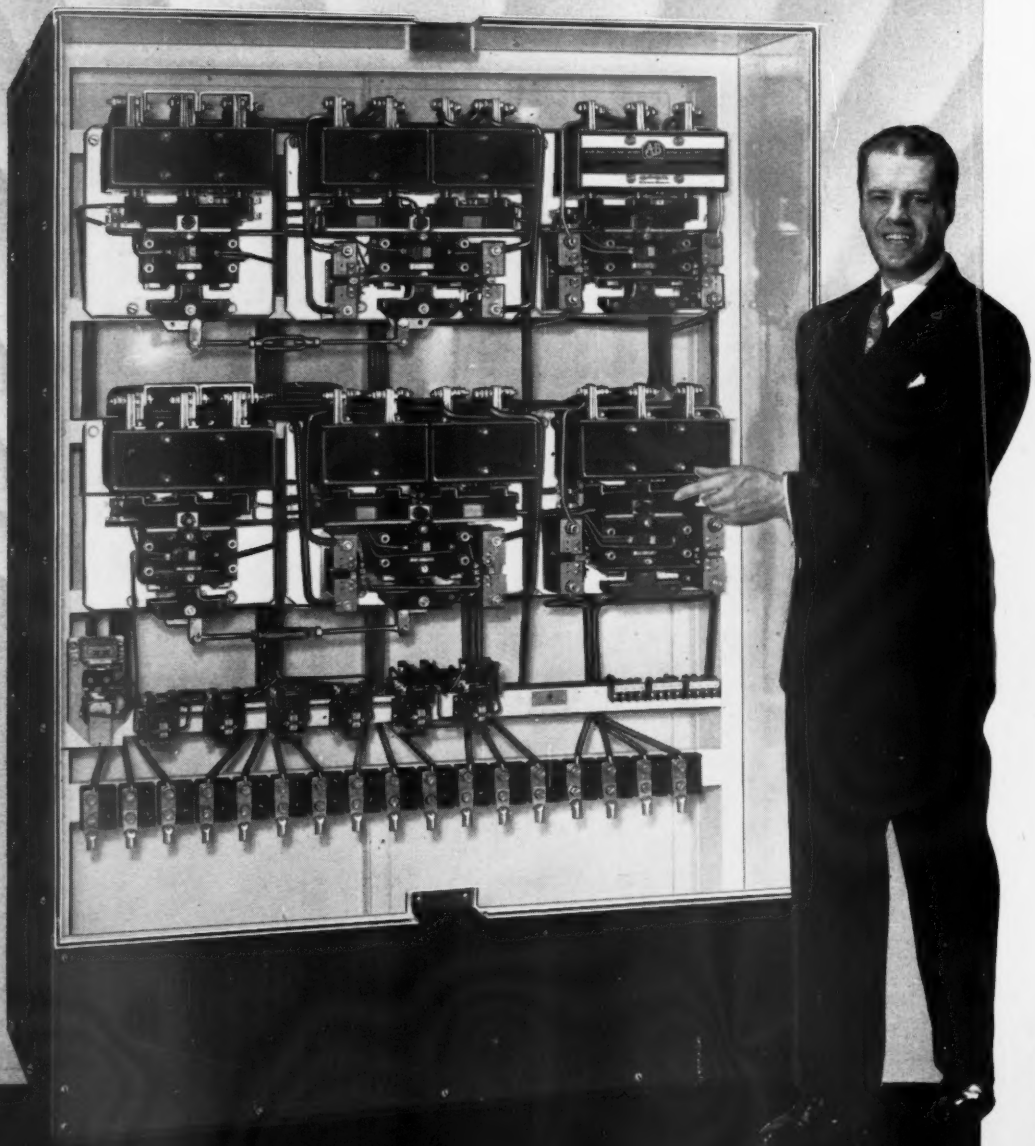

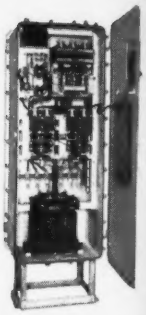

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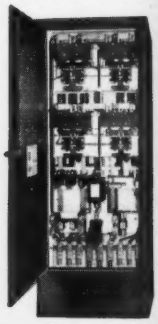
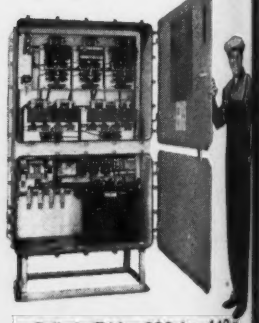


Bulletin 762—150 hp, 440 v, Automatic Slip-Ring Motor Starter. Stepless acceleration.

Bulletin 922—150 hp, 220 v, Automatic Transformer-type Synchronous Motor Starter.



Bulletin 746—200 hp, 440 v, Automatic Reduced Voltage Starter in water-tight enclosure.

A-B Quality

ALLEN-BRADLEY

SOLENOID MOTOR CONTROL

QUALITY

Operating Your Small Motor Department [FROM PAGE 57]

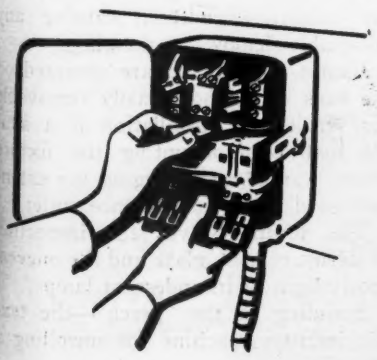
skills. The attendant chart of job standards for small motor repair shops is a digest of the job classification chart compiled by H. E. Grant of our Nashville, Tenn., shop. These job standards have been approved by the War Manpower Commission and are recorded in the WMC dictionary of job titles and requirements. Use them as a guide in setting up your own standards and in justifying the essentiality of your key men.

Pricing Methods

What system of pricing small motor repair work has been proven best? I am thoroughly convinced that the flat rate system is the only method to use. Those who object to it say it is too rigid and you will lose money on certain jobs. You can remedy this. In wording your printed price list, protect yourself by using bold face type, supplementary foot-notes setting forth exceptions to the flat rates for obsolete and specially constructed types of motors; for dual speed and dual voltage motors and many other exceptions which time and thought will bring to light. The system is no more rigid than you make it.

Good Profits

How long is our electric motor repair industry going to frown on small motor work and consider it as a necessary evil? We should have a sufficient number of specialized small motor shops throughout the entire country to take care of the present and future demands for this type of service. Good profits can be made in this business if you are willing to take the time and effort to learn and understand how to economically operate a small motor shop. But it will require your close attention.



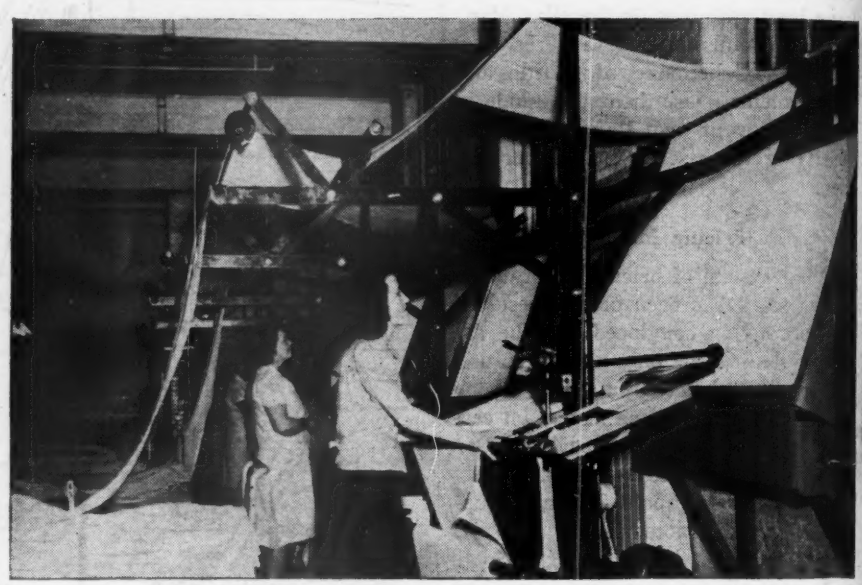
MODERN LIGHTING

HIGH QUALITY ILLUMINATION FOR ENGINE REPAIR

The precision tasks involved in repairing and reconditioning engines for Uncle Sam's war planes requires cool, efficient illumination of high quality and high quantity. Fluorescents have the characteristics of providing an even, glareless, and virtually shadowless type of artificial light in comparison to other widely used sources.

At the Army Air Forces big Air Depot in Galena, Washington, near Spokane, where engine repairs are made, continuous rows of Westinghouse industrial two and three lamp lighting fixtures are used to flood the working areas with an average of 30 foot-candles maintained illumination. Daylight fluorescent 40-watt lamps are used to give the desired quality.

In the high-bay area of repair dock interior shown in the accompanying photograph, the mounting height of the units is approximately 28 feet. Mounted end to end, the fixtures arranged in rows spaced on 12½ foot centers.



***FASTER AND BETTER** inspection of miles of textiles has resulted from the use of a new Sylvania fluorescent inspection fixture first utilized at the Verney Mills, Manchester, N. H.*

FLUORESCENT INSPECTION DEVICE SPEEDS TEXTILES

A new fluorescent lighting device, developed for inspecting fabrics in textile mills but potentially useful in similar inspection of other translucent materials, has been originated by Sylvania Electric Products Inc.

Catalogued as the T-1 Sylvania Inspection Fixture, the device replaces former inspection methods which were unsatisfactory. The initial user, the Verney Mills of Manchester, N. H., reported greatly improved quality control. It was also reporteed that each operator's daily output was increased by an average of 1,000 yards or approximately 20 to 25 percent.

The unit consists of a wooden box four feet long, three feet wide and one foot deep, containing eight 40-watt fluorescent lamps. The face of the box is a large sheet of opal glass, which diffuses the light so completely it is not possible to tell how many lamps are beneath it. Alternate lamps may be extinguished to reduce the brightness, without causing any noticeable shadows on the glass.

Lamps and ballasts are mounted on the back of the box, easily removable for servicing. Installation is a simple matter of mounting the fixture where wanted and plugging the extension cord into a convenience outlet.

The fixture solves the inspection problems of heat, glare and the uneven, spotty light of incandescent lamps.

Standing in the "perch"—the textile industry machine for unrolling a

***CONTINUOUS ROWS** of fluorescent units installed on 12½-foot centers provide upwards of 30 foot-candles of maintained illumination at working levels.*

BACK AGAIN

POPULAR "DAY-LINE" INDUSTRIAL FIXTURES

Again Available with Porcelain Enamel Reflectors

HEAVY-DUTY RLM DAY-LINE — always the favorite because they combine the ultimate in lighting efficiency with quick installation "ICE-TONG" hangers, low-cost maintenance and easy accessibility.

The RLM DAY-LINE
Single unit, for two or three 40-watt or two 100-watt lamps. Bulletin F-77.

The RLM DAY-LINE
Continuous runs, for two or three 40-watt or two 100-watt lamps. Bulletin F-77.

DAY-LINE "W" and "WS" Series with "Snap-on" Reflectors

The "W" Series — non-metallic reflectors with Day-Brite's exclusive "Super-White" enamel . . . The "WS" Series — porcelain enamel reflectors . . . Both types available for single-unit installation in two 40-watt, three 40-watt and two 100-watt models . . . Bulletin F-76.

GET FULL INFORMATION

Contact your local Day-Brite engineering representative or write for the Bulletins which contain complete, valuable information fully describing and illustrating both continuous and unit mounting Day-Line Fixtures—including dimensions, mounting diagrams, photometric data, weights and prices.

DAY-BRITE LIGHTING, INCORPORATED
5432 Bulwer Avenue — St. Louis 7, Missouri

Day Brite LIGHTING FIXTURES

DAYBRITE db
The Sign of Quality
Look for this Label

Nationally distributed through all leading electrical supply houses

Modern Lighting

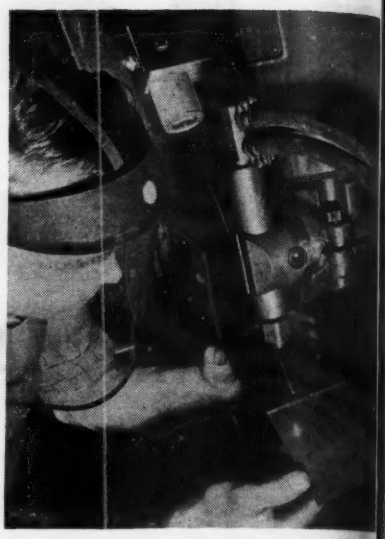
[FROM PAGE 100]

bolt of cloth for inspection—the operator views the fabric as it passes over the opal glass face and marks the cloth where defects are seen.

The fluorescent device is used for inspecting various types of cloth "in the gray," or before bleaching, dyeing or printing. It displaces the two former inspection methods—viewing the cloth stretched across the face of a window opening on the north for the sake of relatively even "north light," and across a horizontal, flat bed using incandescent lamps.

The "window" type of inspection is unsatisfactory because the quantity and quality of natural light varies during the hours of a day, and even more because of weather and the changing seasons. It also is a bottleneck in war production because round-the-clock inspection is impossible.

The incandescent lamp apparatus increased the fatigue factor for employees because of heat and glare conditions, and where flat-bed tables were used, operators complained of cramped and stiffened muscles. The new device is easily set up in a slanting position, so that inspection may be made from a comfortable position.



***BABY SPOTLIGHT** speeds spot-welding of aluminum and steel sheets for fighting planes and other war equipment. A. B. White, Westinghouse research engineer, devised this pin-hole lamp which throws a tiny dot of light on the tip of the copper electrode of a resistance welding machine. When sheets of aluminum are placed between the electrodes this pin-point of light shows the operator the exact spot at which the weld will be made.*

FLUORESCENT SHADES GIVE SOFT LIGHT

The use of flexible translucent Plexiglas shades over fluorescent valance and ceiling lamps provide a soft, smooth lighting effect in the dining car of the New York, New Haven & Hartford line pictured below. The shades can be quickly and easily removed for cleaning and replacement of lamps, thus assuring maintenance of high, comfortable lighting levels.

While the shades are light in weight they are also flexible and of high strength which is of particular importance in railroad cars, buses, boats, planes, etc., where bare tubes exposed to the proximity of the passing public would be subject to breakage.

Because the shade material, which is manufactured by the Safety Car Heating and Lighting Co., can be made in any shape or form, plus its other characteristics of strength, flexibility, light weight and translucency, it is finding effective use in residential and commercial decorative lighting.

***TRANSLUCENT** shades of Plexiglas are used for the fluorescent ceiling and valance lamps in this dining car of the N. Y., N. H. & H. rail line.*

G-E PAVES THE WAY FOR

General Electric Presents Two More Postwar Lighting Interpretations!

How can the lighting industry give its customers the full benefit of modern lighting techniques in the lighting of postwar homes, stores and offices?

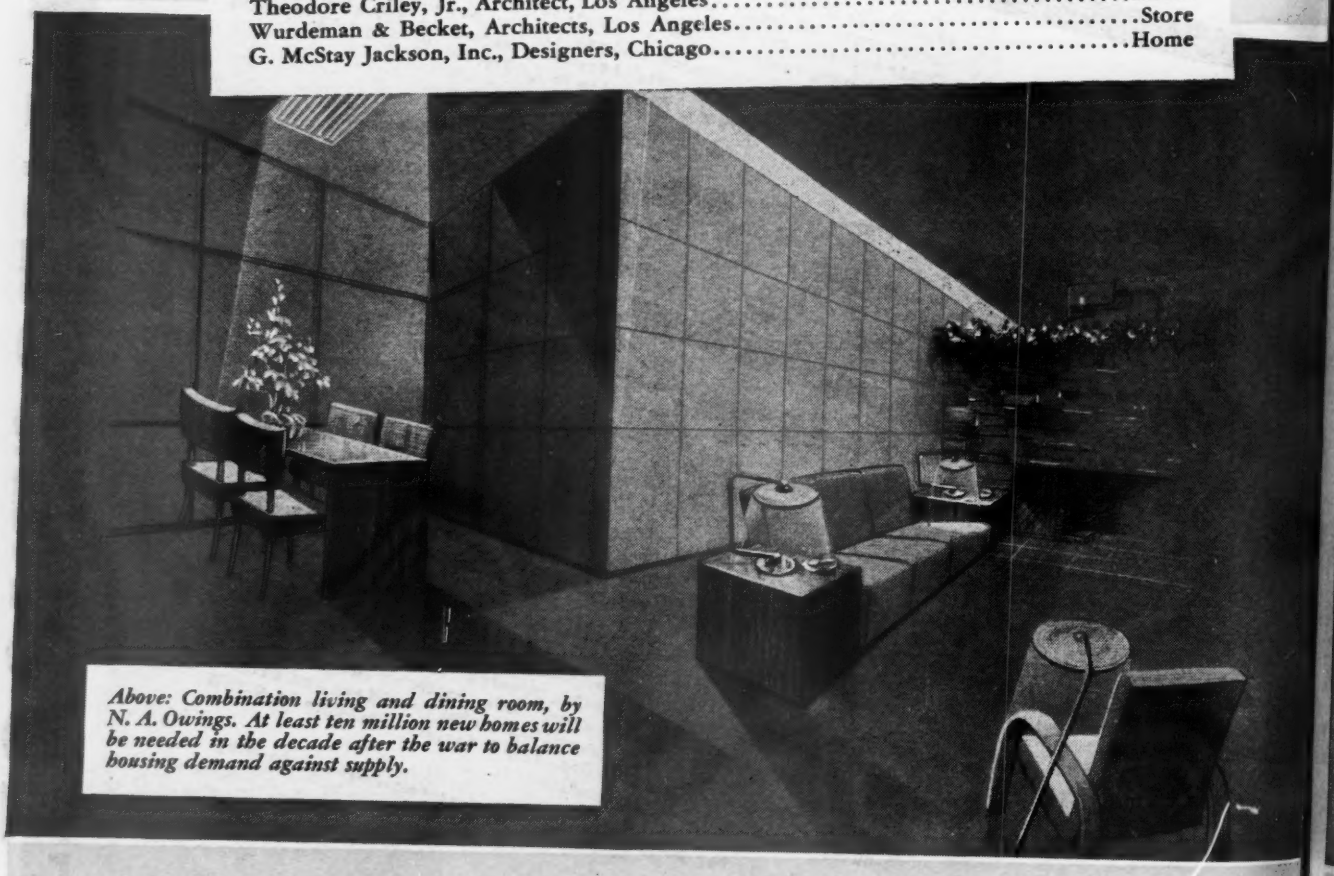
Ten architects and designers have been commissioned by General Electric to work out their answers to that question. Two examples of their work are illustrated below. They contemplate a radical improvement over existing standards, but one that will be practicable with tools that exist today or can be made available quickly as soon as conditions permit.

Complete details of these two postwar lighting plans developed by Mr. Owings and Mr. Arens will be made available in the near future.

Meanwhile, if you would like booklets describing results of the first two G-E commissions, (a postwar food store and a postwar drug store) please write to Div. EC-G, G-E Lamp Department, Nela Park, Cleveland, Ohio.

THESE ARE THE ARCHITECTS AND DESIGNERS AND THE JOBS THEY ARE DOING

Morris Sanders, Architect, New York.....Food Store
J. Gordon Lippincott, Industrial Designer, of Dohner & Lippincott, N. Y.....Drug Store
Egmont Arens, Industrial Designer, New York.....Small Department Store
Helmuth Bartsch, Architect, of Holabird & Root, Chicago.....Home
Graham, Anderson, Probst & White, Architects, Chicago.....Department Store
N. A. Owings, Architect, of Skidmore, Owings & Merrill, Chicago and New York.....Home
William Edward Kapp, Architect, Detroit.....Office
Theodore Criley, Jr., Architect, Los Angeles.....Home
Wurdeman & Becket, Architects, Los Angeles.....Store
G. McStay Jackson, Inc., Designers, Chicago.....Home



Above: Combination living and dining room, by N. A. Owings. At least ten million new homes will be needed in the decade after the war to balance housing demand against supply.

GENERAL ELECTRIC

Hear the General Electric radio programs: "The G-E All-Girl Orchestra" Sunday 10 p. m. EWT, NBC; "The World Today" news, every weekday, 6:45 p. m. EWT, CBS

POSTWAR LIGHTING PROGRESS

Read What People Say About G-E's Design Program:

COMPLETE information on the plans and suggestions of all these outstanding architects and designers is being placed at the service of the architectural profession, fixture manufacturers, lighting companies and the potential buyers of better lighting. Advertising coverage includes scores of magazines.

Dozens of comments already have been received, welcoming the project as a major contribution to better postwar lighting. These are just a few:

"Will greatly assist in stimulating postwar lighting business."

"You are to be congratulated for the development of these visualizations."

"Installations of this kind are certainly right up our alley."

"All of us here feel that you are taking a very constructive step to higher lighting standards in anticipation of tremendous postwar activity."

"You could hardly have selected a theme of greater current interest."

"Should prove of great interest to all who are now attempting to formulate their postwar modernization plans."

"The architectural program on postwar lighting is certainly a good one and, from our point of view, it is mighty encouraging."

This department store budget shop by Egmont Arens, is typical of the way modern lighting for selling can be put to work in the 1,500,000 commercial establishments that will need relighting after the war.

G-E MAZDA LAMPS

KEEP BUYING WAR BONDS — KEEP THE WAR BONDS YOU BUY

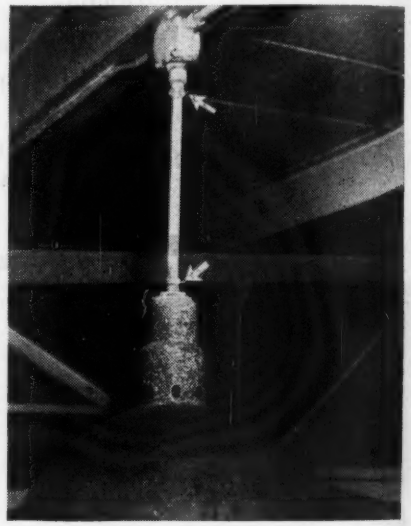
Modern Lighting

[FROM PAGE 102]

COTTER PIN PREVENTS FIXTURE FROM SLIPPING

The relighting program at Clark Bros. Company, Olean, N. Y., called for higher lighting levels when plant operation went on a 24-hour a day schedule. In order to take advantage of the new and efficient light sources, the old d.c. lighting system was replaced by a.c. distribution.

The high-bay areas were lamped with 400 watt mercury vapor high-bay units mounted 31 feet from the machine floor and located on 12 by 15 foot centers. In certain foundry areas



***THIN-WALL TUBING** and threadless connectors are used for the dual purpose of drop and fixture hanger. Cotter pin at top and bottom connectors assure against loosening.*

where mounting height was somewhat lower, deep dome reflectors were used.

Both main feeders were run open-wiring with branch circuits leaving the panels in thin-wall conduit. The thin-wall conduit was also used for hanger drops to the fixtures, but with the use of threadless connectors the problem arose as to safety. Should the connector loosen from vibration, it was entirely possible that the fixture might slip off the end with only the wires and electrical connections holding it.

As shown in the accompanying photograph, holes were drilled through the connector and the conduit. The hole was fitted with a cotter pin to remove any possibility whatsoever of a fixture coming loose. Note that each end of the conduit hanger drop is cottered, that is, the upper connector at the swivel-ball joint and at lower end where the connector joins the tubing and the fixture.

Whatever the lighting problem

SOLA makes the correct

TRANSFORMER

Lighting was called upon to do a tremendous job in 'round-the-clock war production. Lighting did it—in the factory, in the office, in the home. Lighting methods have changed and the transformers that supply the power have changed with them.

In effecting these changes in transformer design SOLA engineers have contributed an impressive array of *original* engineering concepts.

War-time restrictions still surround many of the transformers that we are now manufacturing for important assignments in the war effort—yet the day is not far distant when these new designs, priority free, will be available to the lighting industry.

★

FLUORESCENT LIGHTING. In this important field SOLA'S new transformers have been closely aligned with the new developments in tubes and fixtures. Our ballasts for long continuous lamps, in which we have included our famous Constant Voltage principle, have been responsible for the unvarying light intensity in hundreds of important war plants regardless of the unstable voltages induced by unpredictable power demands.

SOLA transformers for fluorescent lighting still rate top preference with important fixture manufacturers. Ask for Bulletin JFL-86.

SERIES LIGHTING. For street lighting, protective lighting, runway markers, flood lights—wherever the power supply must be sealed against dust, moisture and weather, SOLA'S new Series Transformers have excelled in performance under the most exacting military requirements. Ask for Bulletin JSS-97.

POWER DISTRIBUTION transformers of the conventional double wound, auto types, either step-up or step-down, have also been modernized to meet changing conditions. Ask for Bulletin JDW-101.

MERCURY LAMPS • STREET LIGHTING • FLUORESCENT • AIRPORT LIGHTING • PLANT LIGHTING

SOLA Lighting Transformers

Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs Oil Burner Ignition • Radio • Power • Controls • Signal Systems • Door Bells and Chimes • etc. **SOLA ELECTRIC CO., 2525 Clybourn Ave., Chicago 14, Ill.**

Answered by
F. N. M. SQUIRES and GLENN ROWELL
Chief Inspector
New York Board of Fire Underwriters
New York, N. Y.
Electrical Engineer
Fire Underwriters Inspection Bureau
Minneapolis, Minn.

QUESTIONS ON THE CODE

USE OF METAL BOXES

Q. *"Referring to the Supplement to National Board of Fire Underwriters pamphlet No. 70 approved August 7th, 1940, Section 3372, Page 19S. Has this section been amended so that this type of cable may be used with metal boxes? I have been informed that some Inspection Bureaus are permitting the use of metal boxes with this type of material, provided the bare conductor is insulated with a high voltage sleeve in the outlet box."—H.G.*

A. The reference given above is to Emergency Amendment No. 43, approved April 9th, 1942. This amendment made effective for the duration only, a new Section to the Code, Section 3372, to apply only to defense emergency buildings of certain types.

This amendment permits, under the restrictions noted above, the use of non-metallic sheathed cable, having one circuit conductor without individual insulation but assembled with one or more insulated conductors beneath an overall fibrous covering. Such cable is often referred to as "covered neutral cable" to differentiate it from the regular "non-metallic sheathed cable" which has all of the conductors fully insulated. The outer "overall fibrous covering" is not considered as an insulation.

The Section (3372) then concludes with the requirement that junction boxes, outlet boxes, covers and switch and receptacle plates used with this type of cable shall be of non-conductive material. There has been no amendment to this requirement. Section 3372 also contains the requirement that where metal distribution cabinets are used with this "covered neutral" cable the metal of the box shall be bonded to this grounded circuit conductor (neutral). This, however, does not imply that metal outlet boxes may be used nor that if they are used, as has sometimes been done because of the scarcity of the non-metallic boxes, that the boxes may be grounded to the neutral wire.

Of course, a "high voltage sleeve" (whatever that is) over the bare neutral in an outlet box would help prevent contact between this wire and the box, if properly applied, and provided the uninsulated conductor is a single solid wire. In some cases, however, the neutral is stranded which makes it harder to get the strands together and effectively covered especially at the point where they enter the box and which is at the point where they are under the cable connector or clamp. This sleeve would also not be considered as insulation.

If metal outlet boxes are to be used by special permission of the inspection department having jurisdiction, because of the impossibility of obtaining non-metallic boxes, and if they are so located (on metal lath. wall or ceiling, or in conductive locations) so as to require the grounding of the boxes or of the fixtures attached to them, they should be grounded by means of a *separate* grounding conductor and *not* grounded to the neutral.—F.N.M.S.

In the days ahead, Code problems and questions will take on new importance. An expanding industry in flux; new methods, new men, new materials and new responsibilities will bring the Code into new perspectives in its relationship with the folks who must work with it.

It is inevitable, therefore, that this department of *Electrical Contracting* should be broadened in scope. As a forum for the discussion of everyday Code problems with Code authorities, it must be geared to meet the increasing needs of our readers.

To broaden the base of experience and daily contact with a wide variety of Code and inspection problems available to our readers, F. N. M. Squires will be assisted by a panel of consulting editors over the country. In this issue, we are pleased to welcome Glenn Rowell, electrical engineer of the Fire Underwriters Inspection Bureau of Minneapolis. Mr. Rowell is widely known throughout the North Central area as an able and distinguished authority on Code matters.—W. T. Stuart, Editor.

EXPLOSION-PROOF SWITCH

Q. *My customer has purchased an air pressure actuated warning device that sounds a bell whenever a car approaches the pump island. This device has an ordinary pressure operated switch that is intended to be fastened to or embedded in the pump island. Should this switch be of the explosion-proof type.—R.T.*

A. Yes, such a switch should be approved for use in a Class 1, Group D location. It would no doubt be advisable, especially at this time, to extend the air line from such a warning device into the station itself or to some other point which would not be considered an explosive area. If extended into the station, the switch should be mounted at least 4 feet above the floor providing cars are serviced within the building.—G. R.

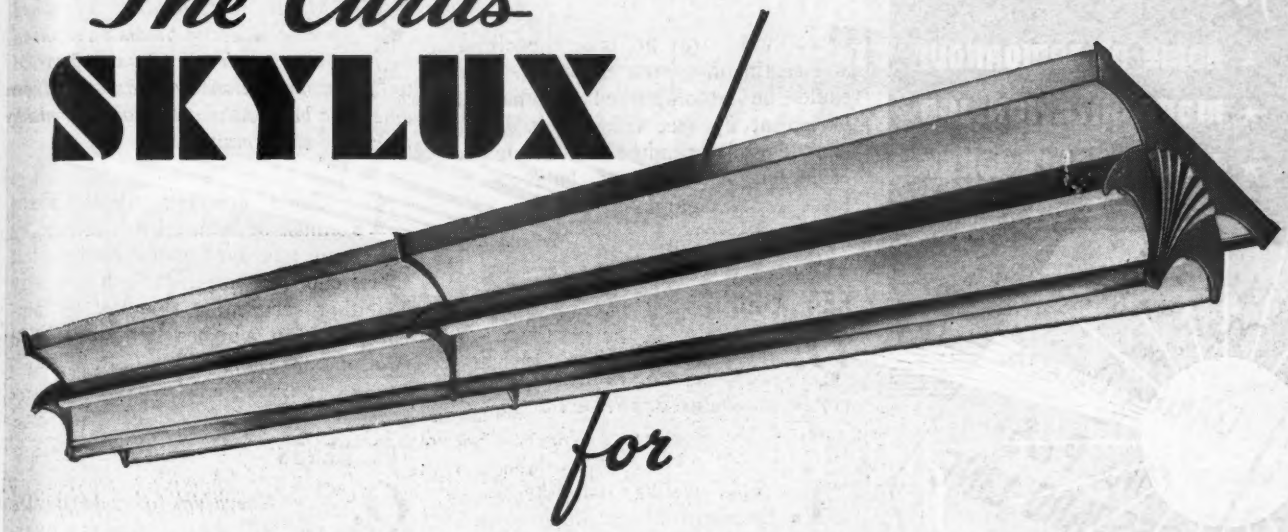
MEANS OF SUPPORT

Q. *"I have two 600 foot runs of 4-inch conduit each containing four 500,000 C. M. cables. These are to be suspended on hangers. How far apart should these supports be?"—A.Z.*

A. The Code does not give any specifications as to the distance between supports when suspending conduit as it is expected that a job entailing the supporting of such weights as indicated above would have to be well engineered from a mechanical aspect rather than from the electrical angle.

As the run of conduit is undoubtedly made up of full 10-foot lengths it would

The Curtis SKYLUX



for

HIGH LIGHT OUTPUT
and
SCIENTIFIC SHIELDING

The Outstanding Two-Lamp Unit on the Market

Whenever a fluorescent installation demands a combination of high efficiency, scientific shielding, and beauty . . . Curtis SkyLux is by long odds the best unit. An important feature is the shield which conceals the lamp, the inner surface of which is a miniature reflector redirecting the light downward. The reflector finish is efficient, snow-white Fluracite, and there are no horizontal surfaces to collect dust. Thus, the sound principles of SkyLux design produce a unit with a high initial light output which shows but slight depreciation throughout an exceptionally long life.

CURTIS *Lighting*, INC.
6135 WEST 65TH STREET, CHICAGO 38, ILLINOIS

Questions on the Code

[FROM PAGE 108]

probably be well to take the weight and strain off of the couplings. This could be accomplished by hangers placed at 2½ feet from each end of each length of conduit as the weight of each length would be balanced on these two hangars.—F.N.M.S.

REA WIRING

Q. *May non-metallic sheathed cable containing two type El conductors be used for concealed work?—H.E.*

A. This wiring material is approved only for open work in dry locations and therefore may not be used for concealed work. See Interim Amendment No. 69, Section 3005 N.E. Code.—G.R.

Q. *How should non-metallic sheathed cable be protected in stock barns when it passes through a partition between two sections of the barn in which different temperature conditions are possible?—H.E.*

A. Probably the best method is to enclose the cable in a conduit nipple filled with compound which extends beyond the surface several inches on each side of the partition. This stops the accumulation of moisture by condensation from rotting the cable insulation. Where winter weather is moderate, condensation problems are less severe and the use of conduit nipples might not be necessary. Cable should never be pulled through small bored holes barely large enough to permit the cable to be inserted in buildings housing livestock as these holes soon fill with hay chaff. If the cable must be drawn through bored holes, drill holes sufficiently large to assure free passage of air about the cable. Whenever possible cable should be so placed that it will not accumulate deposits of hay chaff and the resulting moist condition that will cause destruction of the insulation.—G.R.

Q. *In the wiring of existing farm dwellings, may non-metallic sheathed cable be notched in tops of floor joists or in studding behind mop boards?—H.E.*

A. Yes, providing the cable is protected by metal plates or conduit nipples to prevent nails being driven into it when the floor or mop boards are replaced. See Section 3017 N.E. Code.—G.R.

Q. *Must non-metallic sheathed cable entering boxes be secured to the box or may they be supported within 6 inches of the box and then enter the box without being secured by means of cable clamps?—*

A. Cable entering metal boxes must be secured to the box by means of approved cable clamps but cables entering non-metallic boxes may be either secured to the box or supported within 6 inches of the box. See Sections 3715 and 3716—G.R.

THE BENDS

Q. *"In referring to code article 346-3471 what degree is a quarter bend? Code says 4 one quarter bends from outlet to outlet or fitting to fitting. Does it mean 45° bend? Would like your opinion."—C.H.M.*

A. One full circular turn or bend is 360°. Therefore a "quarter bend" is ¼ of 360° or 90°. For further discussion see the December 1943 issue of *Electrical Contracting.*—F.N.M.S.

TYPE SN CONDUCTORS

Q. *We have been hired to rewire a gasoline filling station that has been closed for some time and the circuits leading to the pump islands and outdoor lighting standards are shorted. What type of conductor would you recommend for these underground runs?—R.S.*

A. If the existing conduits can be used, I believe type SN conductors would be most suitable for such an installation.—G.R.

OUTLET BOX ON RIGID CONDUIT

Q. *Can an ordinary outlet box be used on a rigid conduit installation in a Class 2, Group G risk?—B.F.*

A. Inasmuch as a Class 2, Group G location contemplates grain dust which is not conductive, the Code does not prohibit the use of an ordinary outlet box providing it contains no sparking or arcing parts. However, if metal or conductive dust are present, all boxes would have to be of the dust-tight type.—G.R.

Questions on the Code

[FROM PAGE 110]

PAINT SPRAY BOOTHS

Q. *May approved vaportight fixtures be placed within a paint spray booth?—J.A.*

A. No lighting fixture of any type shall be located within spray booths.—G.R.

Q. *May an approved explosion-proof motor be placed in the exhaust duct leading from a spray booth to operate the exhaust fan?—J.A.*

A. No motor of any type shall be located either in the booth or ducts leading from it.

See Section 5024 of the N.E.C. Lights or motors are prohibited in these areas due to the fact they must dissipate heat to function properly and a lighting fixture or motor cannot dissipate heat when covered with paint spray residue. When this heat is confined, it will continue to accumulate until either the paint residue ignites or the motor windings fail. Illumination within spray booths must be brought in from the outside and this can best be accomplished by the use of booths equipped with ¼ inch wire glass panels set in flush with the inner surface of the booth. These panels may be located in the side walls and ceiling of the booth to assure adequate lighting and lighting fixtures, preferably of the vaportight type, may be so placed that they will direct light through these panels. By applying a light petroleum jelly to the inside surface of the wire glass panels, illumination within the booth can be maintained at a high level. The design of the booth will determine the amount of paint residue that will accumulate on the wire glass but if it has been properly greased, the residue can be readily removed with a cloth or waste and another light coat of the petroleum jelly should then be applied. —G.R.

IAEI MEMBERSHIP

Q. *"Would like information about wiring, code changes, and recommendations. Is there any organization national or local which an electrician can join or subscribe to, which will give him first hand information to the above mentioned?"—W.J.S.*

A. There is. It is the International Association of Electrical

Inspectors, often referred to as the IAEI.

This organization is composed primarily of electrical inspectors as active members, but anyone interested in the electrical light, heat and power industry may become an associate member.

The IAEI issues a bi-monthly News Bulletin containing articles of great value and interest to its members, code changes, code discussions etc, etc. To its members are also mailed a considerable amount of literature as well as copies of each new National Electrical Code as it is issued, copies of Underwriters' Laboratories List of Inspected Electrical Appliances each year, etc.

No one in the electrical industry can very well afford not to be a member. The dues for active membership are $3.00 per year and for associate members $4.00 per year.

The Headquarters are at 612 North Michigan Avenue, Chicago 11, Illinois.

Applications for membership may be obtained from IAEI headquarters, or from almost any electrical inspector, or will be furnished upon request from this magazine.—F.N.M.S.

EMT IN CHURN ROOM

Q. *Would an electrical metallic tubing installation be acceptable in the churn room of a creamery?—W.B.*

A. Yes providing water-tight fittings are employed and all boxes, switches, etc. are water-tight. See Section 3484, N. E. Code.—G.R.

OFFICIAL INTERPRETATIONS

by the

Electrical Committee of the N.F.P.A.

Interpretation No. 252

STATEMENT . . . An electrically-operated oil circuit-breaker can be opened or closed by means of a control switch or push button and, in addition, is provided with a mechanical manual closing means which, however, is not to be used on an energized circuit; the breaker can be tripped manually by hand.

QUESTION . . . Is it intended by the term "manually operable" in the various provisions of Article 230 (sections 2351-a, 2354, 2389-d, and 2392 of the 1940 edition of the National Electrical Code) that an energized service switch can be both closed and opened by hand?

ANSWER . . . Yes.

PRACTICAL ARTICLES on the application, installation and maintenance of electronic apparatus in industry. Readers are invited to contribute items from their experience to this department. Articles used will be paid for.

ELECTRONICS

Installing, Maintaining, and Servicing Electronic Relays and Timing Relays—I

A detailed outline for the electronic technician to follow in installing, maintaining and trouble-shooting electronic relays.

By E. D. Schneider
Industrial Control Engineering Division
Electronics Section
General Electric Company

ELECTRONIC relays and electronic timing relays are important members of the rapidly growing family of industrial electronic control devices. As their applications become more widespread, general information concerning their installation, maintenance, and servicing becomes increasingly important.

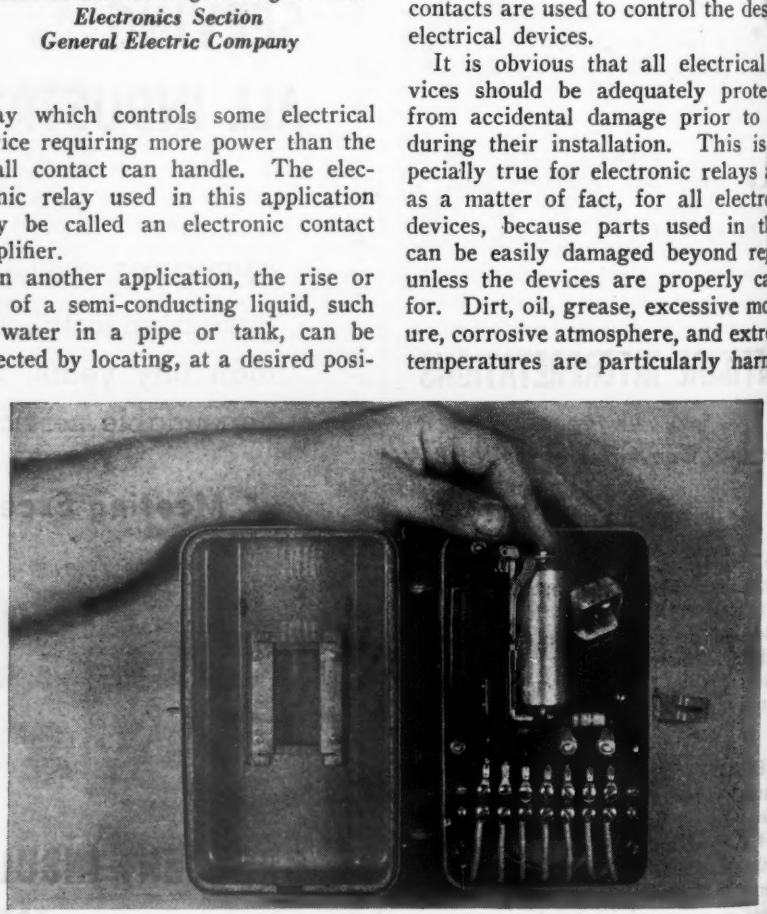
Electronic Relays

Whereas the term "electronic timing relays" instantly gives one a definite idea regarding the nature of such devices, the term "electronic relays" is not as specific. Strictly speaking, the term "electronic relays" would include a large variety of electronic devices, such as photoelectric relays, electronic timing relays, electronic contact amplifiers, etc. In this article, the term "electronic relays" will apply only to those devices, whose function it is to open and/or close *control circuits for other electrical devices* in response to the opening or closing of a circuit which by itself is not capable of handling the current required to operate those electrical devices.

Many applications of electronic relays have been made and their field of application is certain to increase in the future. One typical application is an electrical instrument, such as a voltmeter or ammeter, provided with a very small contact on its pointer. This contact is connected to an electronic relay which controls some electrical device requiring more power than the small contact can handle. The electronic relay used in this application may be called an electronic contact amplifier.

In another application, the rise or fall of a semi-conducting liquid, such as water in a pipe or tank, can be detected by locating, at a desired position, electrodes or probes that are connected to an electronic relay whose contacts are used to control the desired electrical devices.

It is obvious that all electrical devices should be adequately protected from accidental damage prior to and during their installation. This is especially true for electronic relays and, as a matter of fact, for all electronic devices, because parts used in them can be easily damaged beyond repair unless the devices are properly cared for. Dirt, oil, grease, excessive moisture, corrosive atmosphere, and extreme temperatures are particularly harmful



TELEPHONE-TYPE MAGNETIC relay on an electronic relay being operated manually to check proper functioning of the contacts.

How to use an RCA Phototube to control "ON-OFF" operations

YALE & TOWNE's "Phantom Doorman" speeds handling of materials, lessens employee fatigue, reduces door maintenance, saves heat loss, reduces noise and drafts, and prevents damage to goods in transit. Time-delay holds door open until truck has passed through.

IN the course of an industrial plant's normal working day, many "ON-OFF" operations occur that require moving a lever, pressing a button, throwing a switch, or making some other physical adjustment either manually, mechanically, or electrically. Many of these operations can be more efficiently, accurately, and often more economically performed by *electronic* control through the use of phototubes. Moreover, many additional things can be accomplished that are not possible by *any* other existing method.

Electronic Door-Openers. An electronic "ON-OFF" control device familiar to many is the automatic door-opener, such as *"The Phantom Doorman"* manufactured by YALE & TOWNE of Stamford, Conn. The magic brain that controls it is the trio of RCA Electron Tubes—a 921 phototube and 2 metal amplifier tubes—as illustrated in the diagram below.

Other Applications. This same principle, of automatically "throwing a switch" by means of a device actuated by the interruption of a beam of light, has almost limitless industrial applications. Sorting or grading objects according to their height or width, for example. Or counting—up to as many as 1000 units per minute, and much higher if electronic counting circuits are utilized. Or for totalizing where, for instance, it's important to know exactly how many items on a production or assembly line were started, completed, and are still in process. Separating objects by color, and counting the number of each. Starting and stopping paint sprayers so paint isn't wasted. Level controlling for bottling or pumping operations. Detecting breaks in continuous paper- or textile-runs and automatically stopping the press or loom when the break occurs. Observing traffic statistics, switching traffic lights, or giving warning by light or bell when a vehicle approaches a hidden corner. And so on *ad infinitum!*

Have You a Problem? Whether your particular interest lies in increasing efficiencies or reducing hazards through the use of electronic door-openers or any other electronic control device, RCA may be able to help you. Why not write to us, stating your problem, so we can refer you to the equipment manufacturer best fitted to serve you? And if you would like our 32-page, illustrated booklet *"Electrons in Action at RCA,"* we will gladly mail you one. Simply write to RCA, Commercial Engineering Section, 639 South 5th St., Harrison, N. J.

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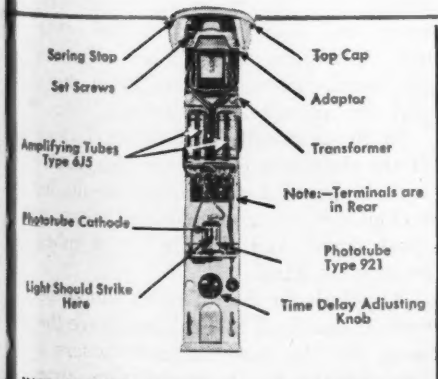
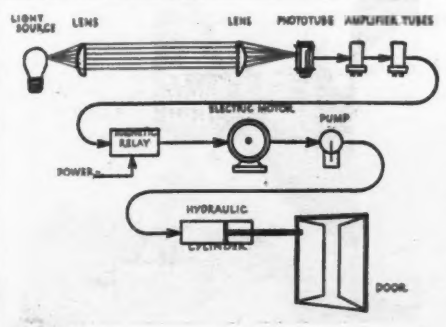


YALE & TOWNE's Photo Relay, showing interior construction and positioning of 3 RCA Electron Tubes.



Schematic diagram of YALE & TOWNE electronically controlled device for automatically opening a door when an approaching person or vehicle interrupts a beam of light.

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INSPECTION SCHEDULE

Electronic Relays and Electronic Timing Relays

FREQUENCY	WHAT TO INSPECT	WHAT TO INSPECT FOR
Every 3000 hours	Electronic tubes	In order to maintain continuity of service, all electronic tubes should be tested and replaced if necessary.
1 to 3 months, depending on frequency of operation.	Contacts of magnetic relay.	Excessive wear, burning or pitting. Replace contacts, if necessary.
		Amount of wipe on normally closed contacts of sensitive relays. Adjust armature stop to obtain about 1/16" clearance between armature arm and spring.
1 to 6 months	Electronic relays, probes, electrodes, and initiating devices used with electronic relays. Electronic timing relays, auxiliary electrical devices. Wiring.	Presence of dirt, metallic dust, and other foreign material. Because of the high impedance of most electronic circuits, such accumulations may cause trouble.
		The presence of moisture will make conditions much worse.
		Particular attention should be paid to probes and electrodes used with electronic relays.
		Leakage resistance of wiring, cables, and panel surfaces should be in excess of several hundred megohms.
3 to 6 months	Connections to terminals and plug connections.	Under conditions of vibration, these connections may come loose. Tighten securely.
3 to 6 months	Auxiliary electrical devices.	Contact wear, loose parts, etc.

to electronic devices not suitably protected. The careful storing and handling of electronic devices are vital factors for all installations.

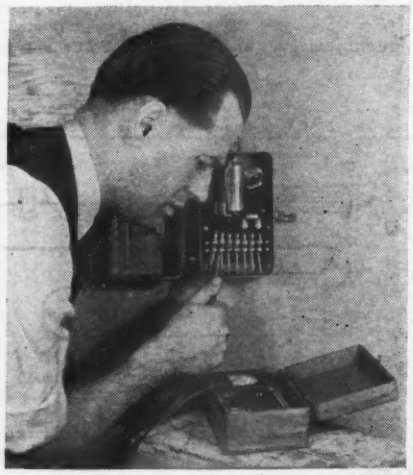
Electronic devices are usually supplied without the tubes installed, the required tubes being shipped separately in their own cartons. These tubes should be carefully stored in a place where they will not be damaged and they should not be removed from their cartons until they are to be installed.

Planning the installation of electronic relays is also important. Although the wiring diagrams and instruction books furnished with the devices supply much of the detailed information regarding them, it is usually necessary to study thoroughly all conditions from the viewpoint of each particular installation.

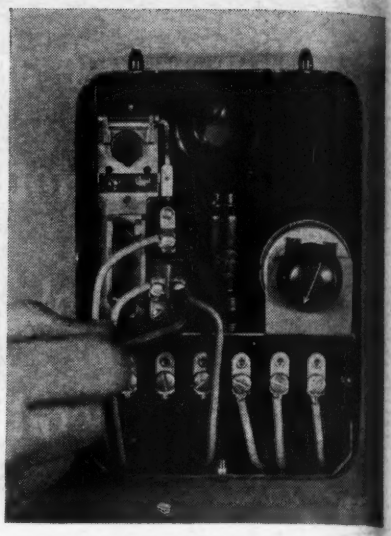
One of the first factors to be considered is the permanent location of the electronic relay and its associated devices. *Locate these as close together as practical so that the wiring between them will be short. Avoid placing the devices where they will be subjected either to excessive vibration or to other harmful conditions such as those already mentioned.*

The leads of the electronic relay can be thought of as control and power leads. The control leads are wires from the initiating device, such as the small contact on a voltmeter or an ammeter, or electrodes in a pipe or tank. The power leads are the wires from the power supply and from the electrical devices to be controlled by the electronic relay. Control connections *should always be kept separated* from power connections to make sure that transient voltages in the power circuits will not be induced in the control circuits.

One way of making certain that there will be no interaction between



ELECTRONIC RELAY being checked for line voltage which should correspond to within a variation of plus or minus 5 per cent of nameplate rating.



TERMINAL BINDING screws on an electronic timing relay being tightened during installation. Care should be exercised not to damage the device by using an over-size screw driver or exerting too much force.

the power circuits and the control circuits is to place them in separate metal conduits or suitable metal enclosures. The conduits should be connected to the enclosing case of the electronic relay and solidly grounded. In addition, for some types of electronic relays, special shielded wires may be required. Recommendations regarding the maximum allowable length of control connections and the type of shielded wire (if any) to be used can be found in the instruction book or can be obtained from the electronic relay manufacturer.

After the installation has been completed, refer to the instructions supplied with the electronic relay and follow the procedure given for putting the equipment into operation.

Inspection

These electronic devices should not require a great deal of maintenance because usually the only moving parts subject to mechanical wear are the relays mounted on the device. Other elements such as resistors, capacitors, tubes, and transformers do not wear out. Although these latter elements are usually conservatively rated there may be an occasional failure.

In those installations where failure of the electronic device and the resultant stoppage of production would be serious, it is recommended that a spare device and a spare set of tubes be kept on hand.

Although the life of tubes should be several years, all tubes do not have the same life. In those instances where a tube failure at an inopportune time would be serious, it is advisable to test the tubes periodically so that a

TROUBLE SHOOTING CHART
Electronic Relays

TROUBLE	CAUSE	REMEDY
Magnetic relay in electronic devices does not operate on signal from initiating device.	Line voltage not within limits specified.	Correct line voltage.
	Defective tubes	Check tubes, or if unable to do so, try new ones.
	Positioning key in center of tube base (radio-type tubes) may be broken and tube has been placed in the socket incorrectly.	Replace tube. If another tube is not available, check mating of tube pins with proper socket holes before replacing in socket.
	Excessive leakage in initiating device (probes, electrodes, or contact) or wiring associated with initiating device—caused by moisture accumulation or poor insulation.	Check leakage resistance of initiating device, associated wiring. Disconnect wires to initiating device from terminals on panel and measure resistance between those wires with an electronic voltmeter-ohmmeter. Total leakage resistance should be well in excess of that for which the electronic relay is adjusted.
	Capacitance of wiring from electronic device to initiating device too high.	Use shorter wires. Install shielded cable according to recommendations of electronic device manufacturer.
	Contact type initiating control doesn't operate.	Repair or replace initiating contact.
	Open magnetic relay coil.	Replace coil or install complete new relay.
	Defective circuit components, such as resistors, capacitors, etc.	If circuit voltages have been included with instructions, check these voltages with a multimeter, as a means of locating the trouble. Otherwise, make a visual inspection of the device for defective parts. Check resistance of resistors and coils with an electronic voltmeter-ohmmeter. The resistance of resistors should be within 10% of the rated value. Check capacitors, other than electrolytic types with ohmmeter. Defective capacitors will show practically zero resistance. Check electrolytic capacitors with capacitance meter. Because of limited life, failure may occur after several years. When replacing, observe polarity.
Contacts on telephone type magnetic relay either stick or do not make good contact.	Insufficient wipe of normally closed contacts.	Bend armature stop to obtain about 1/16" clearance between armature and contact spring.
	Contacts worn badly.	Replace contacts or entire relay.
Electronic relay operates erratically.	Variations in line voltage outside the limits specified for the device.	If possible, use a better regulated power supply, such as is ordinarily used for lighting circuits. Otherwise, install a constant-voltage transformer if electronic relay is designed for a-c.
Magnetic relay on the electronic device opens and closes at a rapid rate.	Grounded side of power supply on wrong terminal of electronic relay.	Grounded side of power supply must be connected to terminal as specified in the instructions. If device operates from a-c and power supply cannot be grounded, a 1-to-1 ratio transformer should be installed and the proper terminal of the relay grounded.
	Capacitor which is connected in parallel with the relay coil may be open.	Replace capacitor.

tube which is nearing the end of its useful life can be detected and replaced. Radio type tubes can usually be tested at a radio store. However, if an installation has a large number of tubes (perhaps 50 or more) in use, it may be more economical to have a suitable tube tester available in the maintenance shop. Keeping accurate records provides the experience data necessary to future maintenance procedures and scheduling. And more important, they will indicate the stock requirements necessary for successful maintenance operation.

All devices should be kept clean and free from dirt and moisture. Do not use oil on any of the parts. If contacts or other moving parts show excessive wear, readjust or replace them. A guide for periodic inspection is given in the chart labelled "Inspection Schedule."

Trouble Shooting

If a piece of equipment has been operating satisfactorily and then stops for no apparent reason, a preliminary servicing may reveal the cause of the trouble. A suggested procedure to follow is:

1. Check the power supply to the equipment.
2. Check all fuses.
3. Carefully inspect all equipment other than the electronic devices.
4. Examine all connections.
5. Inspect the electronic devices.

a. Examine the contacts on the relay to determine if they open and close properly when the relay is operated by hand. Frequently, a slight adjustment of either the armature stops or the contacts, to compensate for contact wear, is all that is required.

b. Replace the tubes, one by one, to determine whether a tube has failed. Check the operation of the equipment each time a tube is replaced.

Experience has shown that this procedure will take care of the majority of failures, but if the preliminary servicing does not reveal the cause of the trouble, it is necessary to search further. More detailed servicing instructions are given in the acompanying "Trouble-Shooting Chart."

Electronic Timing Relays

The usual electronic timing device is provided with a magnetic relay that is energized or de-energized a definite time after an external initiating switch has been operated. The relay's response to the operation of the initiat-

(Continued on page 122)

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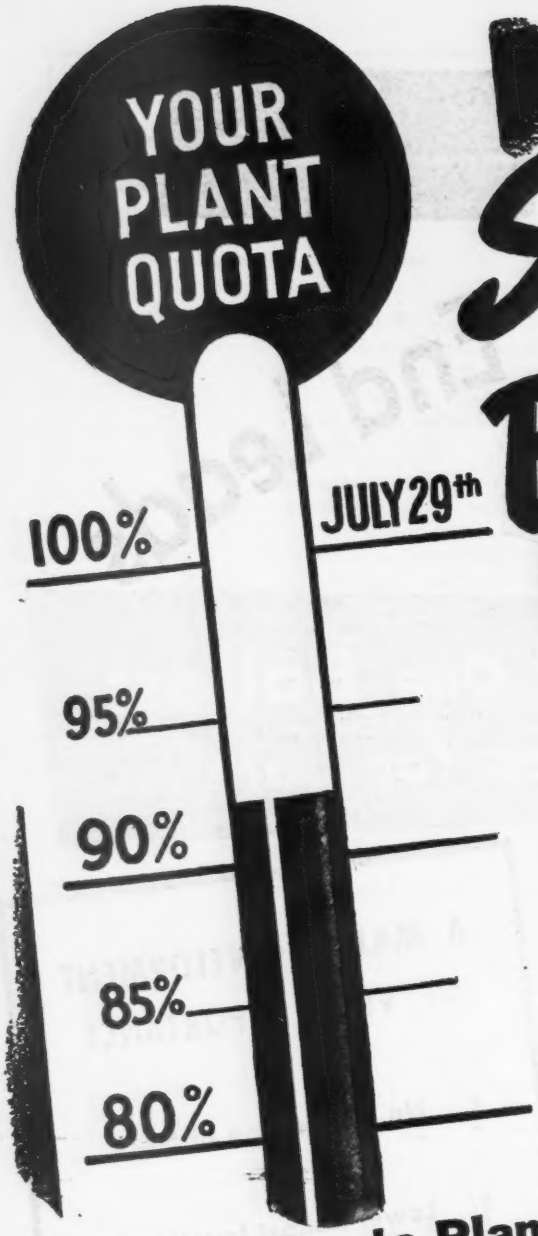

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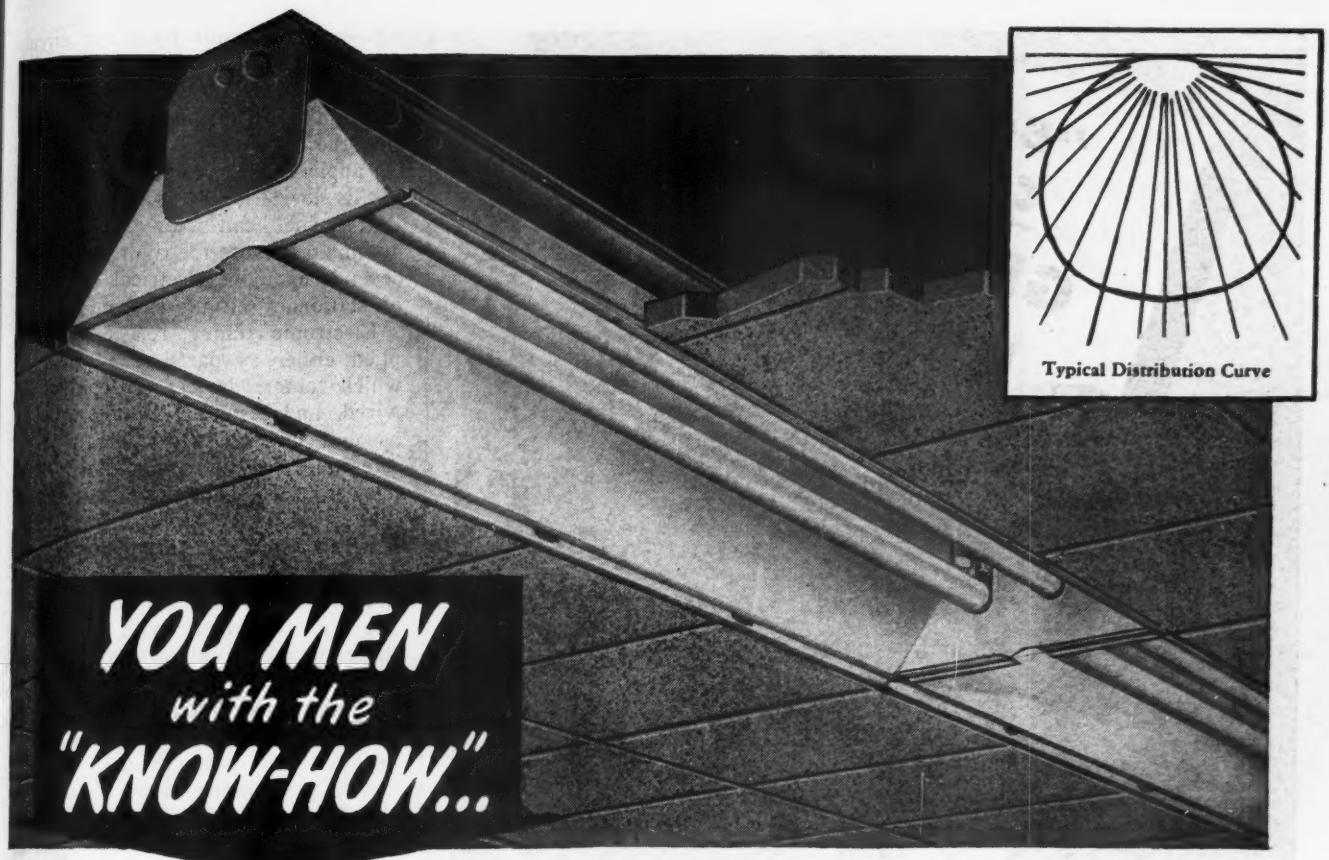

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ing switch depends upon the circuit employed in the electronic timing device. For this reason, it is possible to build electronic timing relays to meet the requirements of a wide range of applications. Another advantage of this device is its few moving parts. Parts which can wear out are at a minimum because the timing operation depends upon the electrical conditions of stationary circuit elements.

Electronic timing relays are supplied either as parts of a panel on which other devices are mounted, wired, and tested at the factory, or as unit devices to be installed and interconnected by the user with other devices to make a complete equipment. The installation of a factory built panel is usually straight-forward because it is only necessary to make connections to the terminal boards on the panel in accordance with the wiring diagram. If the initiating contacts for the timers and the time adjusting potentiometers are not on the panel, control leads to these parts should be kept separate from power leads.

The precautions to be observed in the installation of unit-type electronic timing relays are similar to those already mentioned for electronic relays except that shielded wires for control connections usually are not required but nevertheless control and power connections must be kept separated.

One question that invariably arises in the application of electronic timing relays is:—can a single initiating contact serve the two purposes of initiating the timer and energizing a load such as the coil of a relay, contactor, or solenoid? Although many successful applications of this type have been made, there have been several which have been unsatisfactory. In these cases, inconsistent timing was caused by the bouncing of the initiating contact when it closed. The transient voltage that appeared across the initiating contact because of the momentary interruption of the load current was being impressed in the grid circuit of the electronic timing relay. In most cases, the trouble was corrected by using two contacts—one for initiating the timer and the other for energizing the load. As a result of these experiences, it is recommended that separate contacts be used when a timer is to be initiated at the same time that a load is to be energized. A single contact may be used if actual tests on completed equipment prove that satisfactory operation is obtained.

Scheduled maintenance of electronic timing relays is similar to that given for electronic relays.

Next month, a detailed account of the trouble-shooting procedure together with charts and specific uses of the cathode ray will be presented.

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Electronic Auxiliaries—3

Third in a series. Transformers are frequently used in the circuits of electronic apparatus. This article reviews the fundamentals behind their application.

By R. B. IMMEL
Westinghouse Elec. & Mfg. Co.
East Pittsburgh, Pa.

4. *Transformer*

A transformer in its simplest form usually consists of an iron core and two or more windings which link the same magnetic circuit. The transformer provides a means for transforming from one voltage or current to another in an alternating current circuit. As shown by Fig. 14, one very common form of transformer consists only of the iron core, and primary and secondary windings. The winding by which energy enters the transformer from the power source is known as the primary; the winding from which energy leaves and flows to the load is termed the secondary.

When an alternating voltage is impressed on the primary winding of a transformer, it sets up an alternating current in the winding which in turn produces an alternating magnetic field in the iron core. As approximately all of the alternating magnetic flux in the core links both the primary and secondary windings, alternating voltages are induced in both windings. The e.m.f. induced in the primary winding is a counter voltage and limits the current in this winding. The e.m.f. induced in the secondary winding produces a secondary load current.

The voltage induced into a winding by a varying magnetic field is directly proportional to the rate of the magnetic field change and the number of turns in the coil winding. Since the primary and secondary windings of a transformer are linked by the same flux, the induced voltages will be directly proportional to the number of turns in each coil. As the resistance of the primary winding is usually relatively low, the induced voltage in this winding is almost equal to the applied voltage from the power source. Therefore, the voltage induced in the secondary winding is approximately equal to the primary or applied voltage multiplied by the ratio of the number of secondary winding turns to the number of primary winding turns. This relationship for the diagram shown by Fig. 15 may be approximately expressed as:

$$\frac{E_p}{E_s} = \frac{N_p}{N_s} \text{ Or } E_s = \frac{E_p N_s}{N_p} \text{ where}$$

E_p = primary voltage in volts
E_s = secondary voltage in volts
N_p = primary winding turns
N_s = secondary winding turns

Transformers are usually designed so that the losses are very small. The windings usually have very low resistance which results in a very low I^2R or heating loss. The cores are made of a high grade and laminated steel sheet which keeps the eddy current and hysteresis losses to a minimum. Similar to the induction of voltages and currents in a coil, a varying magnetic field will induce currents into the iron core which results in heating and power losses. These eddy current losses can be reduced to using thin laminations which may have a relatively high resistance to eddy currents.

The energy that can be stored in a magnetic circuit is proportional to its reluctance (reluctance is directly proportional to the magnetic circuit length divided by the cross-section area and the material) and the square of the magnetic flux. As a transformer usually has a low reluctance in the magnetic circuit, the energy stored in the core is usually small and the rate at which energy enters the magnetic circuit is at all times almost equal to the rate at which energy leaves the magnetic circuit. As the *ampere-turns* in the primary winding are almost equal to those in the secondary winding, it follows that the currents are proportional to the turns and the approximate formula:

$$I_p N_p = I_s N_s \text{ Or } I_s = I_p \frac{N_p}{N_s} \text{ where}$$

I_p = primary current in amperes
I_s = secondary current in amperes
N_p = primary winding turns
N_s = secondary winding turns

From the above formula it can be seen that a transformer may be used to either step-up or step-down the line voltage or to increase or decrease the load current with respect to the primary current. A transformer is frequently used to insulate one circuit from another since there is no electrical connection between the windings. A transformer is an exceedingly efficient device and its efficiency may be as high as 99 percent for a large power rating.

For electronic tube applications transformers are often made with a multiple number of secondary windings or with taps on the secondary winding to provide the various voltages required

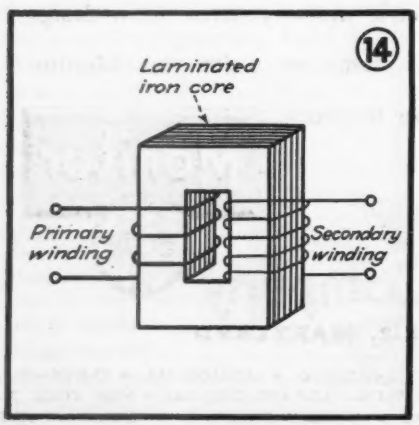

FIG. 14. Iron core transformer

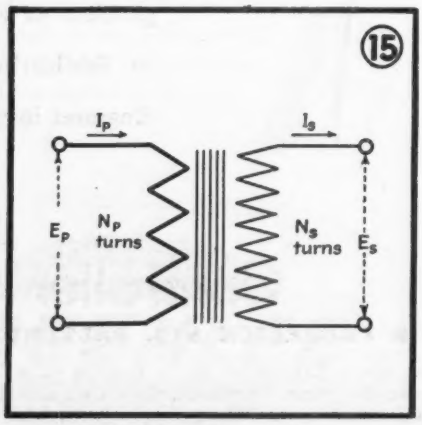

FIG. 15. Transformer diagram

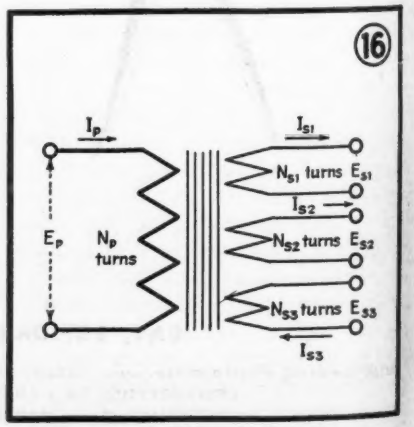

FIG. 16. Multiple winding diagram

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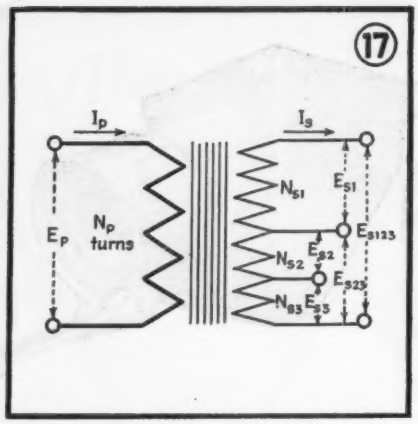

FIG. 17. Multi-tapped transformer diagram

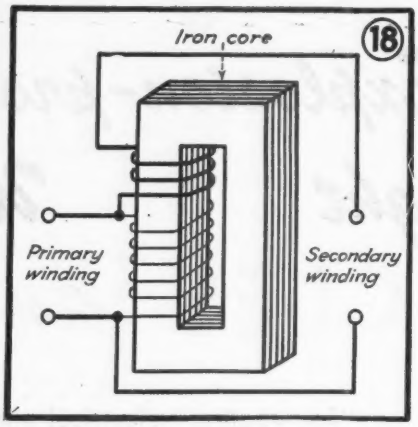

FIG. 18. Auto-transformer for boosting primary voltage

to operate the tube and its auxiliary apparatus.

Fig. 16 shows a multiple winding transformer. This type of transformer is often employed to supply the low voltage filament or heater circuits and the relatively high voltage plate circuits of a rectifier. The voltage, current, and turn relationship previously discussed apply equally well to the primary and any one of the secondary windings.

A multi-tapped secondary winding transformer is shown by Fig. 17. The secondary induced voltages between any two taps are proportional to the total number of turns between the taps. The transformer voltage and current equations previously discussed also hold true for this type of transformer. A transformer with this type of secondary winding is often used with a tap-changing switch to provide a number of different secondary voltages. It is not as universal in application as the multiple winding type as the individually tapped windings are not insulated from each other.

Transformer action may be utilized with only one coil winding which serves the double function of both primary and secondary winding. Fig. 18 shows the core and winding arrangement of an auto-transformer. Fig. 19 shows the connection diagram for an auto-transformer which may be used to boost or buck (lower) the primary voltage. The equations for the voltage, current, and turn relationship are the same as those given for the other types of transformers.

The principal advantage of this type of transformer is that a large saving in the winding copper can be effected when the ratio of transformation is relatively small. The current which flows in the winding section common to both the primary and secondary is relatively small and is the vector sum of the out-of-phase primary and secondary currents. The section of the winding which is not common must be large enough to carry the total load current.

The auto-transformer is usually limited in application to the voltage correction of boosting or lowering the line voltage for small voltage transformations. It has the disadvantage of

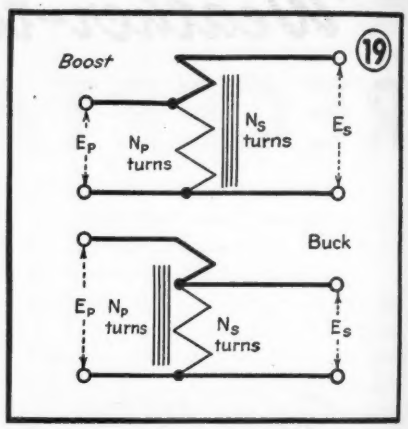

FIG. 19. Auto-transformer connection to buck or boost primary voltage

a direct electrical connection between the primary and secondary circuits.

A transformer will not function on a direct current circuit as its principle of operation depends upon an alternating magnetic field. The transformer windings usually have a very low resistance and may be quickly damaged by the application of a high direct current voltage. However, in a series direct current circuit it will act similar to a choke or an inductance coil.

WORLD-GIRDLING PROVING GROUND

The production here — and the maintenance there of ships, planes, tanks, guns, ammunition for service at the four corners of the globe, has proved a proving ground for welding cable.

From it comes super-flexible cables to withstand repeated flexing.

—tough jackets to resist mechanical abrasion

—slick surface to shed dirt and grease

—non-kinking for ease of handling and for safety.

—Collyer Welding Cables.

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Near you is a Collyer representative ready to cooperate with you on welding wire.

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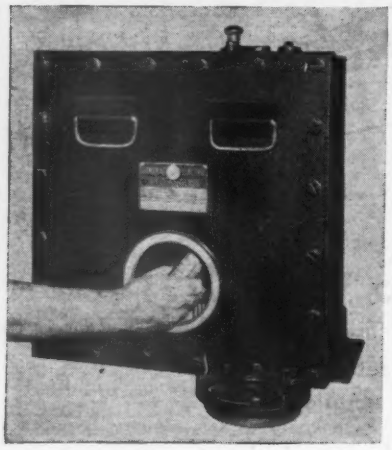
THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising departments, tell them in what issue of ELECTRICAL CONTRACTING you saw the item and they will send full details to you.

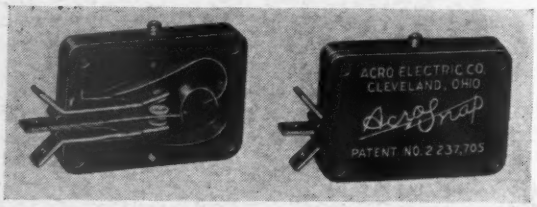
EQUIPMENT NEWS

Explosion-Proof Starters



G-E STARTER

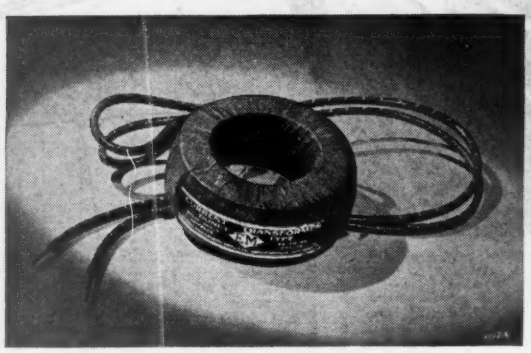
A new line of alternating current, full-voltage explosion-proof starters for use in gaseous mines has been announced. They are especially designed for use on equipment subject to inspection by the United States Bureau of Mines. Available up to 50 hp. in the reversing type and up to 100 hp. in the non-reversing type, starters are housed in explosion-proof enclosures fabricated of steel plate. Wide flange between cover and body of enclosures is ground to close tolerances to prevent escape of burning gases. The switches, contactors, and overload relays of these starters are of the heavy duty type and are designed and located to permit a variety of magnetic interlocked control arrangements. General Electric Company, Schenectady, N. Y.



ACRO SNAP SWITCH

Snap Switch

The new Miniac snap-switch is only $\frac{11}{64}$-in. thick, $\frac{13}{16}$-in. high and $1\frac{7}{16}$-in. long. It is engineered on the rolling spring principle, but with a new design and smaller size. It is fully enclosed in a bakelite case with four mounting holes $\frac{3}{32}$-in. diam. Actuation is with a stainless steel pin plunger. All parts are non-corrosive and contacts of silver. Main blade, contact blade, and rolling spring made of beryllium copper. Rated at 15 amps., 115 volts a.c. Furnished in single pole, normally open and normally closed, double throw. Designed to permit leaf type or overtravel plunger type actuators to be attached to the case. Acro Electric Company, 1338 Superior Avenue, Cleveland 14, Ohio.



E-M TRANSFORMER

Current Transformers

These current transformers, called DoNUT, are of the "inserted-primary" type and for use with any indicating type a.c. ammeter. The transformer is slipped over the bus or conductor to be measured, taped or lashed in place if for permanent installation, and the leads connected to the ammeter. They are built standard in 200/5, 300/5, 400/5 and 500/5 ampere ratios; special ratios can be furnished. Ratio accuracy is 1 percent for ranges above 300 amperes and 2 percent for ranges 300 amperes and below on frequencies of 25 to 133 cycles, and from 15 to 150 percent load. Rated burden is 2 volt-amperes. Lower ratios can be obtained by passing the primary conductor through the transformer two or more times. The transformer is impregnated with insulating, moisture-resisting varnish. Electric Machinery Mfg. Company.

Scatter Box

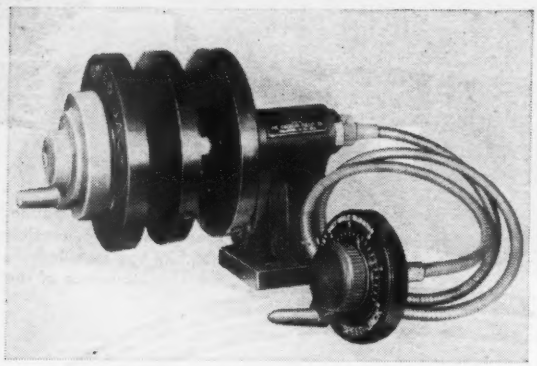
SQUARE D SCATTER BOX

Controlling temporary power and light circuit through a central unit protected by circuit breakers is possible with the newly designed scatter box. It was developed primarily for shipyards and aircraft plants where a number of temporary circuits must be set up and torn down but box is applicable anywhere the same requirements are met. It is built for from four to eight circuits with or without neutral. Circuits are protected by 15 ampere, 115 volt single pole, Type MO multi-breakers. Hinged cover of box can be padlocked. One 1-in. knockout on each end is included and box has a pair of ears for hanging. Receptacles or internal wiring are not provided. Square D Company, 6060 Rivard Street, Detroit, Mich.

Voltage Tester

SQUARE D VOLTAGE TESTER

A voltage tester that tests without lamps, gives positive voltage identification and distinguishes between a.c. and d.c. is available. A.C. voltage markings are 110, 220, 440 and 550. D.C. markings are 125, 250, and 600. Frequencies can be determined by vibrations of the indicator. The device is housed in a cylindrical fiber case, for easy gripping. The 4-inch fiber grips on the leads give complete insulation and leads are 24-in. flexible wire, with double thickness, rubber insulation vulcanized to wire to prevent slippings. Square D Company, 6060 Rivard St., Detroit, Mich.



AMERICAN PULLEY SPEED-JACK

Speed-Jack

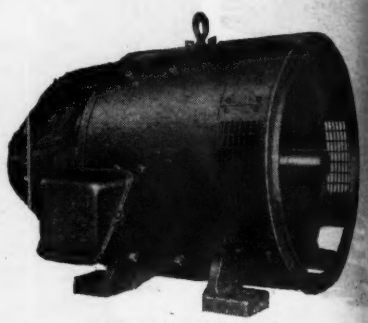
This new variable-speed transmission features simplified remote control and universal mounting, for drives up to 1 hp. Remote control is made through a compact flexible shaft, which makes it possible to mount the unit anywhere in or on the machine and to place the control in a safe location handy to the operator. It may be mounted either vertically, horizontally or in any other position best suited to the equipment. This variable-speed transmission is adaptable to a wide variety of machines, such as band saws, conveyors, drills, internal grinders, lathes, ovens. The American Pulley Company, 4200 Wissahickon Avenue, Philadelphia 29, Pa.

Current Transformer

STANDARD CURRENT TRANSFORMER

A new type N A S current transformer has been designed to meet the needs for a wide range accuracy transformer which enables users to stock only a few sizes to cover entire field of low voltage measurement. It is made in three ratios, 200/5, 400/5 and 600/5 amperes, insulated for circuits not to exceed 1000 volts and capable of high accuracies on burdens up to 25 volt amperes. Features include permanent, easily discernible polarity markings; similar primary mounting dimensions on all three ratios—facilitating interchangeability; practical clamping structure; mechanical connector type primary potential terminal; secondary short circuiting device; tamper-proof sealing facilities. The Standard Transformer Co., Warren, Ohio.

Generators

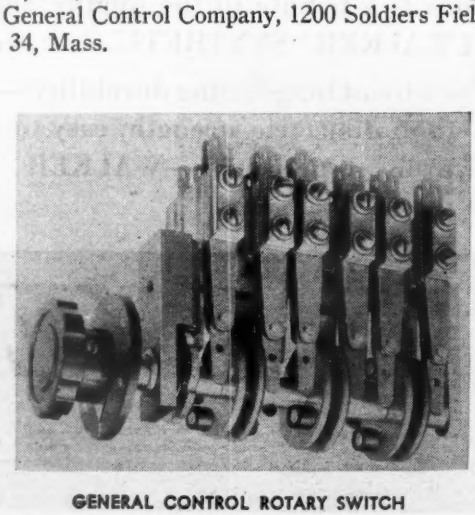


CENTURY GENRATOR

Direct current engine generators are available in sizes 1 to 200 kw. for direct assembly to the engine frame or for belted drive. This generator is constructed to bolt directly to the engine housing and engine shaft. It is equipped with one ball bearing. The engine end of the rotor is supported by the engine bearing. These generators are built for voltages ranging from 15 to 600 volts for a wide variety of applications. Century Electric Company, 1806 Pine Street, St. Louis 3, Mo.

Rotary Switch

This new rotary cam lever switch is designed for one to six index positions. Any combination of spring leaf contact assemblies are available for each of the six positions. It is adaptable to open or close practically any number of circuits in sequence (or repeat) with a single control knob. A single hole is required in the panel for mounting, and contact assemblies in any section can be removed from frame by removing a bolt. Some of its features are circular cams for locating up to 12 low-friction, spring type actuators, cast aluminum frame, bakelite cams and rollers, static shielding, nickel plated phosphor bronze contact springs, and silver contacts. Switch is rated at 10 amperes, 125 volts, a.c., and is built to meet Government specifications. General Control Company, 1200 Soldiers Field Road, Boston 34, Mass.



GENERAL CONTROL ROTARY SWITCH

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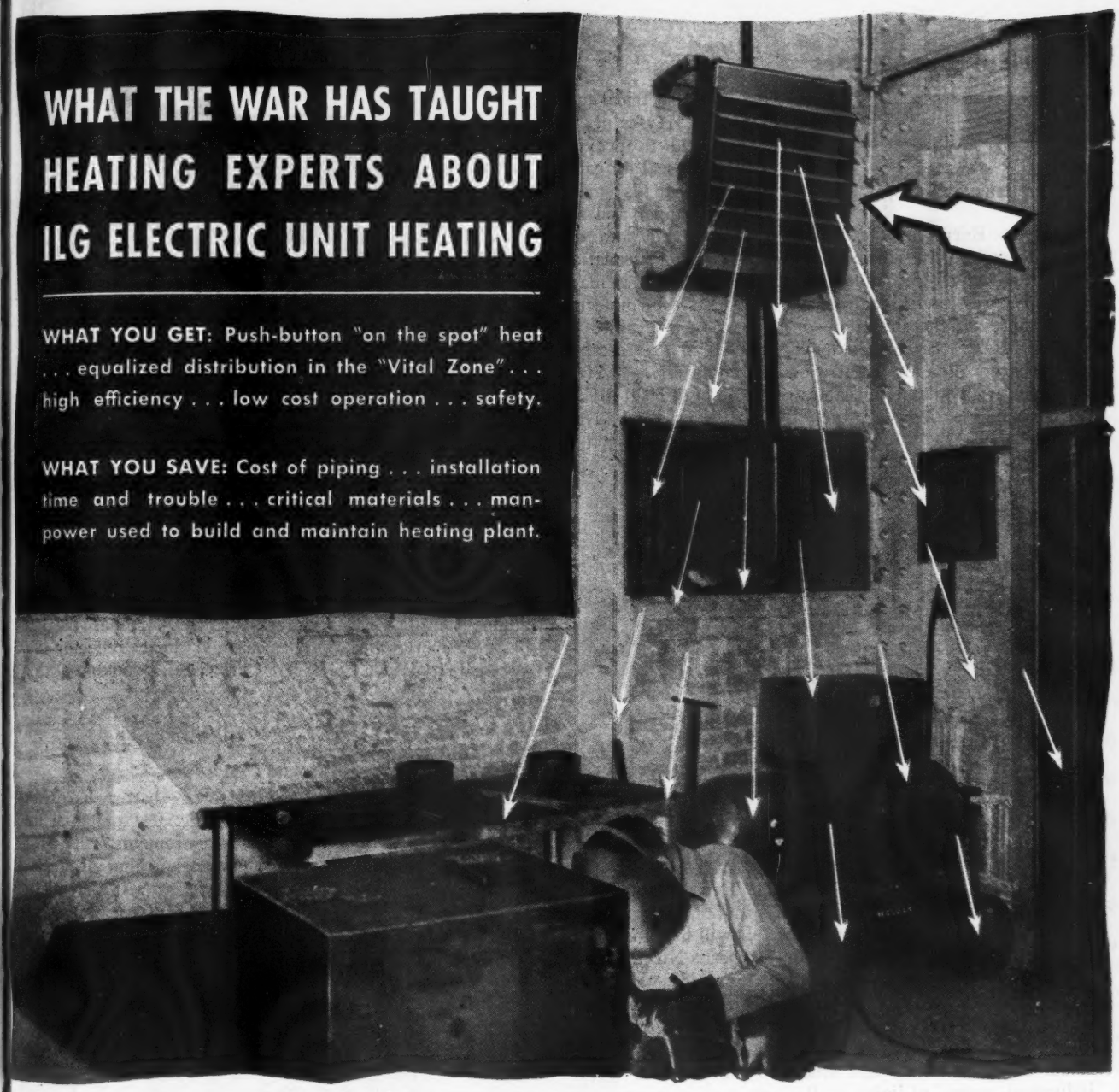
WHAT YOU SAVE: Cost of piping . . . installation time and trouble . . . critical materials . . . manpower used to build and maintain heating plant.



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Electrical Connectors

BURNDY HYSEALUG

This electrical connector, Hysealug, is designed to provide a water seal for cable ends. It is made from copper and silverplated. Barrel of the Hysealug is indented onto the conductor while the shroud is compressed over insulation to form a water-tight cable-end seal. Installation is made with a Hypress and a dual die which indents the connector and compresses the shroud in one operation for cables up to 1000 MCM. Hysealugs above 1000 MCM are installed with separate dies for indentation and compression. Sizes and types are available for cables from No. 4 to 2000 MCM. Burndy Engineering Co., Inc., 107 Bruckner Blvd., New York 54, N. Y.

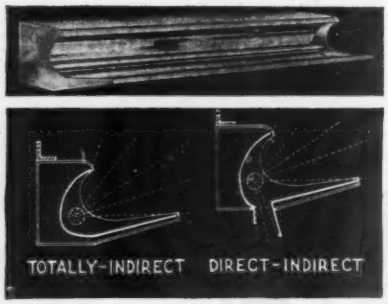
McGILL TOGGLE SWITCH

Toggle Switch

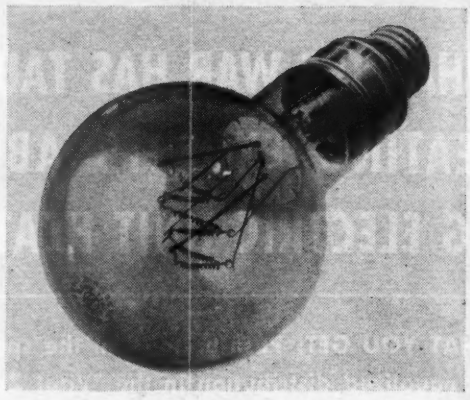
A new small, thin toggle switch has been developed. Its construction is dust and vibration proof and its body is 1-in. long, ½-in. wide and ½-in. thick. It will fit into shallow openings. Switch is made in three types. No. 25 single pole, rated 6 amp. "T" 125 volts; 3 amp. 250 volts. No. 27, three way, rated 6 amp., 125 volts. No. 28 two-circuit, no off position, rated 6 amp. 125 volts. All types furnished with wire leads or solder lugs. It is for use on small tools, appliances and office machines. Also for the individual control of lights in Pullman cars, passenger cars and buses, interior lights in autos, airplane and trailer lights, camera projectors, wall, floor and table lamps. McGill Manufacturing Company, Inc., Valparaiso, Ind.

Germicidal Fixture

This new line of germicidal fixtures is to disinfect the air within schools, offices and industrial plants. It is for use with the G. E. Uviarc tubes. Disinfection of air is effected by means of ultra - violet rays which kill germs. Available in totally indirect and a direct-indirect type. The application of each type is dependent on individual circumstances. The Edwin F. Guth Co., 2635 Washington Ave., St. Louis 3, Mo.



GUTH GERMICIDAL FIXTURE



WABASH INFRA-RED LAMP

Infra-Red Lamp

This new infra-red lamp reduces tunnel glare. It is known as the Lo-Glo MM filament and is of coil-coil construction. It burns at a lower color temperature, reducing spectral glare, and increasing radiant energy output. The shape of the MM filament eliminated "cold spots". It is claimed that the service life of the new lamp is nearly double that of ordinary drying lamps. It has the heat-proof Superlok base and ceramic heat reflector disc. Wabash Appliance Corp., 345 Carroll St., Brooklyn 31, N.Y.

Insulation Tester

A new spillproof lightweight storage battery is used as a power supply for the 500 volts d.c. test potential used in making insulation resistance measurements, with Model C-2 megohmer. The system employed is that of stepping up the low voltage battery to a steady test potential of 500 volts d.c. by means of a special vibrator transformer circuit built into the instrument. A special charging circuit is built into the instrument which makes it possible to charge the battery either from a.c. or d.c. at any time. Features are direct reading in megohms and ohms, wide coverage and readability, sensitive meter movement with knife edged pointer and mirror scale, guard circuit to prevent errors through surface leakage. Herman H. Sticht Company, Inc., 27 Park Place, New York 7, N. Y.

Multi-Contact Timer

CRAMER TIMER

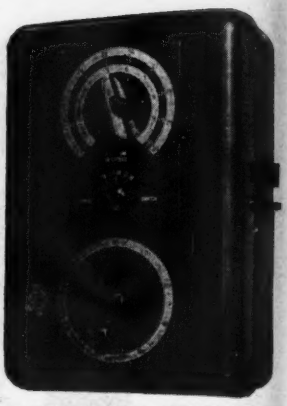
A new multi-contact timer for remote control has been announced. It is used to control a series of machine operations in definite order —to automatically reverse or alternate in operation a group of motors, machines or devices—to operate in a predetermined sequence a series of signals, valves or solenoids. Its solenoid starting mechanism is operated from a remote control momentary start button, so that the timer will go through its complete cycle or any part of its cycle of operation and stop. Reclosing the momentary start button will either continue or repeat the cycle as the case may be. They can be arranged so that in the event of a power interruption it is necessary to again press the remote control start button to continue the cycle, or, after power is restored to automatically continue the cycle of operation. The R. W. Cramer Company Inc., Centerbrook, Conn.

Capacitors

CAPACITOR

A new line of rectangular oil-type capacitors has been announced. Made in standard container sizes and in voltage ratings up to 6000 V.D.C.W., these new capacitrons meet Army and Navy specifications, including total saltwater submersion tests. Types BC and BCR can withstand high ambient temperatures and have minimum capacity loss in sub-zero operation. Type EC is for mounting through a single hole. Unit locks on chassis by solid nut and lockwasher. Container is insulated. A ring can be supplied for grounding either of two insulated terminals. Type CC is recommended where flexibility of mounting is desired. The Capacitron Company, 318 West Schiller St., Chicago 10, Ill.

Spot Welding Control



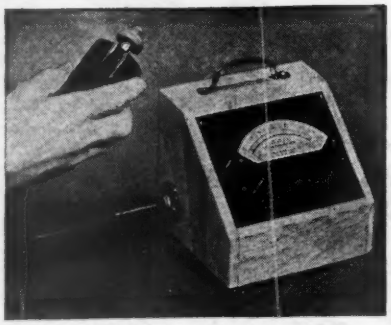
G-E TEMPERING ATTACHMENT

A new tempering attachment, for use with G. E. synchronous spot-welding controls which incorporate the phase-shift method of heat control, has been announced. The new auxiliary control is particularly suitable for use in the spot-welding of air-hardenable steels. The attachment consists of a heat-control and a time-control adjuster for tempering, and the relays which automatically transfer the additional heat-and-time adjustment from the spot-welding control with which the attachment is being used. It is enclosed in a metal case designed for wall mounting. Calibrated adjustment dials are mounted on the hinged door of case, together with an on-off switch for preventing relays from being energized when ordinary spot or pulsation welding is being done. General Electric Company, Schenectady, N. Y.

Instrument

A new model 700, senior size volt-ohm-milliammeter has been developed. It uses 6-in. round rugged 0–400 microampere meter. It is for direct reading, all calibrations printed on meter scale. Unit is housed in portable oak cabinet. Specifications are 6 d.c. and 6 a.c. voltage ranges: (1,000 ohm per volt) 0 to 15–60–150–300–600–1500 volts; 7 d.c. current ranges: 0 to 3–15–60–150 milliamperes and 0 to 3–15–30 amperes.; a.c. current range: 0 to 3 amperes; and 5 resistance ranges: 0 to 1,000–10,000–100,000 ohms, 0 to 1 megohm and 0 to 10 megohms. Superior Instruments Co., 227 Fulton Street, New York 7, N. Y.

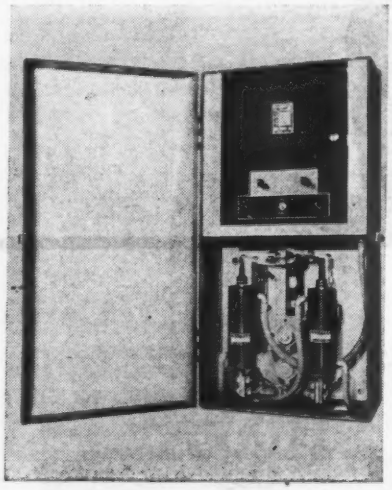
Electrical Tachometer



BRIGHAM TACHOMETER

A new electrical tachometer for every speed measuring requirement has been developed. The power unit is equipped with special sealed ball bearings and a permanent magnet rotor, designed for trouble free operation. By special calibrations on the scale of the indicator, units of miles per hour; revolutions per minute; feet per minute; frames per second; gallons per hour; pounds per minute and any other unit of measure can be read. These direct readings from scale eliminate the necessity of using conversion tables or charts. Power unit has a plastic housing. Four rubber tips are provided so that speeds of any type shaft, whether centered or uncentered, can be determined. R. B. Brigham Company, 327—16th Street, Toledo, Ohio.

Timer-Contact



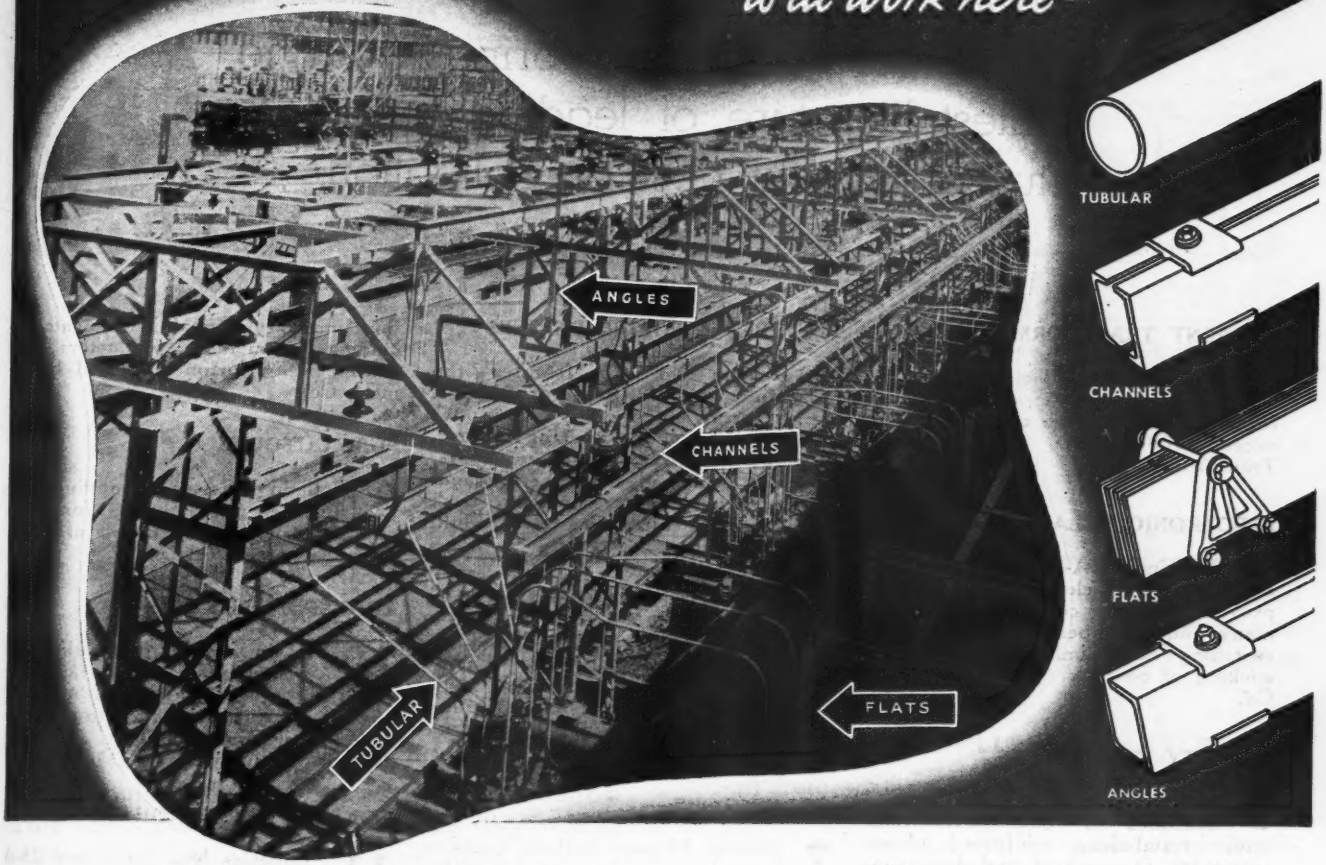
WELTRONIC TIMER-CONTACTOR

Combination timer-contactor "package" units designed to provide automatic, electronic control for resistance welders has been announced. Units may be used with new machines or to convert manually or cam-timed welders for automatic, electronic control. A universal wall or floor mounting cabinet houses any combination of interchangeable Weltronic NEMA type timers, together with a choice of Weltronic ignitron or mechanical type contactors as required for the operation of the welder. A single power supply unit operates all standard control panels from either 115, 230 or 460 volt a.c. lines. The cabinet is 16½-in. wide by 33-in. high and 10½-in. deep. Synchronous timing and heat control may be added at any time without rewiring. Weltronic Co., 19500 W. 8 Mile Road, Detroit 19, Mich.

Magnet Wire

Formex ribbon-rectangular magnet wire is available in shapes as thin as 0.004 inch. It offers many application possibilities to producers of electronic devices and other electric components. It is smooth, strong, flexible and able to withstand high-speed winding without damage to insulation. In coil winding, varnish treatment, assembly and actual operation, this new wire presents many advantages. Because of its thinness, this wire can be applied where round wire previously had to be used. In addition, it will substantially increase the winding space factor and may be used in place of larger-size, rectangular magnet wire to increase magnetic effect or reduce coil size. General Electric Company, Schenectady, N. Y.

The entire family of ALCOA ALUMINUM BUS BARS *is at work here—*



High in electrical conductivity, light in weight, corrosion-resistant, easy to handle; the designers took full advantage of these properties of aluminum in this industrial outdoor substation. Alcoa Aluminum bus bar shapes—channels, angles, flats and rounds—enabled them to meet all mechanical requirements most economically.

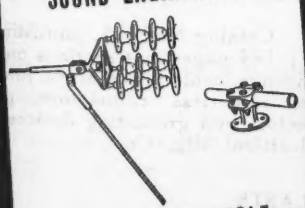
Vital wartime electrical loads are being carried by Alcoa Aluminum bus bars in every type of industry. Generating plants and substations, mills and factories, office buildings, battery rooms in telephone and telegraph systems; all are being supplied with power by these efficient, easy-to-maintain bus bars.

Now that the supply of aluminum exceeds the demands for military uses, Alcoa Aluminum bus bar shapes and fittings are again available. WPB Order M-1-i now permits the use of aluminum for electrical conductors. Users will find that, in installing aluminum bus bars, fewer man-hours are required. The lighter weight of aluminum makes transportation, handling and erection easier.

If you are considering the installation of new bus bars, or the extension of an existing system, consult Alcoa.

Our engineers are anxious to serve you. Write ALUMINUM COMPANY OF AMERICA, 2197 Gulf Building, Pittsburgh 19, Pennsylvania.

SOUND ENGINEERING



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CURRENT TRANSFORMER

1 Bulletin S-502 illustrates and describes Type NAS current transformers, insulated for circuits not to exceed 1000 volts. The Standard Transformer Co.

ELECTRONIC RELAY

2 Bulletin GEA-4214 features CR7511-A electronic relay. It provides floatless control of levels of many liquids; permits pressureless switching and eliminates arcing and sticking of contacts. General Electric Co.

GRAVITY FEED OILERS

3 Bulletin No. 26-B illustrates and describes a modernized oiler with crystal-clear, reinforced plastic reservoirs, in standard and dust-proof models. Trico Fuse Mfg. Co.

INSTRUMENTS

4 Bulletin No. 105 describes volt-ohms - milliammeter; industrial analyzers and meg-o-meter. Illustratrations are also shown. Superior Instruments Company

FIXTURES & WIRING DEVICES

5 Bulletin No. 22 features the Multi line of Navy marine lighting fixtures and wiring devices, including branch boxes, ceiling fixtures, distribution boxes, junction boxes, switches, bulkhead fixtures, combination switches and receptacles, deck and miscellaneous fixtures. Multi Electrical Mfg. Co.

STAGE SWITCHBOARDS

6 Both manually operated and remotely controlled stage switchboards are discussed in this new booklet. It shows the Hub-Regulite system of remote lighting control. Hub Electric Corporation

CONNECTORS

7 A new 12-page bulletin containing information, photographs, drawings and data on this line of electric, laboratory and switchboard connectors. Cannon Electric Development Company

INSTRUMENTS

8 Catalog No. 16, consisting of 32 pages, illustrates and describes this line of electrical instruments, including ammeters, voltmeters and wattmeters. Norton Electrical Instrument Co.

FUSE CUTOUTS

9 Bulletin GEA-4224 outlines the flip-open fuse cutouts for overcurrent protection by means of a fuse link. General Electric Co.

TRANSFORMERS

10 A new folder illustrating and describing dry type transformers with the new internal terminal board. They are designed to meet the needs of wartime economy. Gregory Electric Company

CONSTANT LEVEL OILERS

11 Bulletins Nos. 24-A and 25-A describe an automatically controlled visible oiling method for ring or ball bearings, shafts, gear and pump housings, etc. Trico Fuse Mfg. Co.

CONNECTORS & CLAMPS

12 Catalog No. 525, consisting of 148 pages, illustrates and describes electrical connectors and bus support clamps. Southern States Equipment Corp.

COLD CATHODE LIGHTING

13 A new booklet entitled "Facts About Colovolt Cold Cathode Lighting" gives complete data and many features of this new cold cathode fluorescent lamp. General Luminescent Corporation.

CONDUIT FITTINGS

14 Catalog No. 125, consisting of 144 pages, has sections on conduit fittings, cable terminators, junction boxes, solderless connectors, power connectors and grounding devices. O. Z. Electrical Mfg. Co.

BALLASTS

15 Bulletin 441-FL illustrates and describes ballasts for fluorescent lamps. Data, dimensions, wiring diagrams for ballasts and lamp

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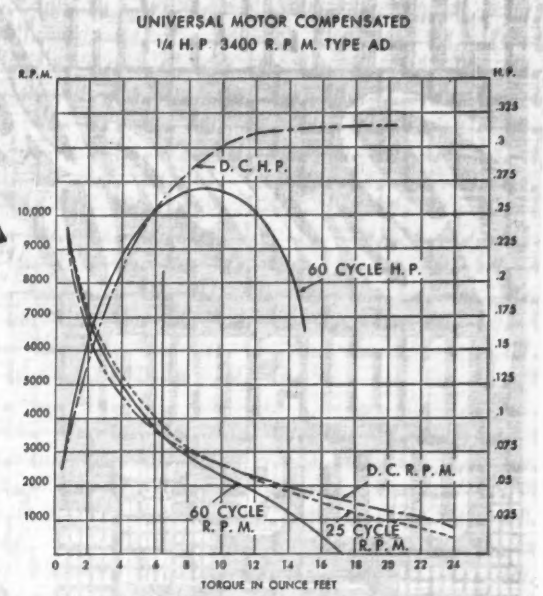
COMPANY .....

ADDRESS .....

CITY ..... STATE .....

Torque Talks

ON MOTORS FOR WAR AND POST-WAR NEEDS



UNIVERSAL MOTORS TO

Solve your housing problems

Selection of the right motor to do a particular job is only half the problem for many a manufacturer. Then comes the need for building it into a housing that can be easily adapted to the product.

This double problem occurs not infrequently in the small motor applications that require the ability of universal motors to operate on a-c or d-c.

Westinghouse Types AD and ADS Universal Motors answer these problems. These are built in a wide variety of ratings to meet any motor need. Moreover, they are available in many different housings, specifically designed and sturdily built to meet the needs of any special housing problem. Or they may be bought as parts for assembly.

These twin advantages of Westinghouse Universal Motors have been proved by literally thousands of applications, ranging from hand tools to business machines . . . food mixers and vacuum cleaners to motion picture projectors and stock tickers . . .

ASK FOR APPLICATION HELP

Small motors have gone to war—some on wartime applications of peacetime products—many others on specialized war applications. For condensed information on Westinghouse Small Motors, the Westinghouse Small Motor Selector (Form B-3075-A) summarizes the data presented in these "Torque Talks". Write today for your copy of this helpful four-page aid to proper motor selection. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. J-03205

PICK THESE MOTORS

• Where a-c—d-c operation is desired	TYPES AD AND ADS UNIVERSAL MOTORS
• Where compact built-in power is needed	UNIVERSAL—a-c or d-c
• Where there is a wide frequency range	CYCLES—0 (d-c) to 60 (a-c)
• Where high torques and high speeds are desirable	HORSEPOWER—1/150 to 1
	SPEEDS—3000 to 12000 rpm

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

SMALL MOTORS

New Literature

[FROM PAGE 136]

switches, and comparative mounting dimensions are given. Jefferson Electric Co.

FLUORESCENT FIXTURES

16 Bulletin F-75 illustrates and describes the Coronado fixture for use in administrative areas such as drafting rooms, engineering departments, offices, etc. Day-Brite Lighting, Inc.

ELECTRICAL EQUIPMENT

17 A catalog on this line of electrical equipment, with sections on floor boxes, busduct, panelboards, and cabinets, knife switches, fuse blocks, fuse terminals and pressure connectors. Frank Adam Electric Co.

CURRENT-REGULATING COMPENSATOR

18 Folder GEA-4207 illustrates and describes electronic current-regulating compensator for thyratron-welding control. General Electric Company.

INSULATING VARNISH

19 A poster giving seven simple rules to follow in using insulating varnish. Also featured is a benzine solvent chart. John C. Dolph Company

ELECTRICAL CONNECTORS

20 Technical Bulletin 6050, consisting of 64 pages, features this line of Hydent connectors with the indent principle of installing electrical connectors. Burndy Engineering Co.

MOTORS

21 A new 12-page catalog on direct current motors. It illustrates motors in sizes ranging from 1/6 to 300 horsepower. Century Electric Company

FASTENING AND HANGING DEVICES

22 A folder featuring this line of outlet box and fixture hangers, conduit clamps, adjustable pipe hangers, BX staple, threaded rods, pipe straps and Romex straps. The Paine Company

ELECTRIC DRILLS

23 A well illustrated booklet covering the history, development, features and specifications of the Thor Plastic-housed portable electric drills. Independent Pneumatic Tool Company

PYRANOL TRANSFORMERS

24 Folder GEA-4193 is entitled "Summary of Safety and Savings with All-Purpose Pyranol Transformers". General Electric Company

Mr. Manufacturer,

CAN YOU TOP THESE?

The quotations used in this advertisement are from responses to the A. N. A. Committee of Paper Saving.

A LEADING COSMETICS MANUFACTURER REPORTS:

"We cut down the size of our gift boxes and standard packages to effect an over-all saving of approximately 25% of the paper and cardboard; standardized our window displays and eliminated all die-cuts, as well as steps, shelves and secondary planes. We also folded all displays in half to save more than 50% of the paper and paperboard normally used."

A BIG PLATE GLASS COMPANY REPORTS:

"Our 1944 Color Book was reduced in size and quantity, resulting in a paper saving of 136,000 pounds. Our Color Cards, of which four or five million are used annually, were reduced in size at an approximate reduction of 50% in paper tonnage. We have eliminated our Dealer Sales Portfolio. Our Color Book has become a 'self mailer,' eliminating need for envelopes."

ONE OF THE TOP LIFE INSURANCE COMPANIES REPORTS:

"In 1944 we will continue to specify lighter weights of paper wherever possible and take all possible steps further to reduce paper tonnage. We are instructing our field offices to scrutinize carefully all requests for printed material and to disapprove all requests for quantities that appear excessive."

A FAMOUS ADDING MACHINE COMPANY REPORTS:

"In advertising and promotion we are using about 30% of the amount of printing and paper used in 1941 — that represents about 2/3 saving. However, further savings will be effected whenever possible this year as last."

Remember

PAPER IS WAR POWER

USE LESS—SAVE ALL WASTE PAPER!

This advertisement contributed by this publication and prepared by the War Advertising Council in cooperation with the War Production Board and the Office of War Information.

New Literature

[FROM PAGE 138]

WIRE REEL

25 Catalog sheet 17-A illustrating and describing a wire reel for light or heavy work. It also features Teleheight, an instrument for figuring heights of poles, trees, wires, buildings or other objects. W. N. Matthews Corporation

DISCONNECT FITTINGS

26 Bulletin 522 gives engineering details on the Sta-Kon disconnect way of wiring. Disconnectable two-way splices, three and four way splices, disconnect terminals, disconnect strips, blocks and others are pictured and described. The Thomas & Betts Co.

COLD CATHODE LIGHTING

27 A bulletin illustrating and describing Kold-Volt fixtures, cold cathode fluorescent industrial lighting. Mitchell Manufacturing Company.

AMPLIDYNE CONTROL

28 Folder GEA-4161A tells "How the G-E Amplidyne Improves Electric-Shovel Operation". Illustrations and curves are shown. General Electric Company

INSULATING MATERIALS

29 A 20-page booklet describing this line of Insl-X products—standard insulating materials, special heat-resistant coating for wire-wound resistors, arc-resistant coating for molded phenolic compositions, protective coatings and corrosion-resisting coatings. The Insl-X Company, Inc.

INSTRUMENT

30 Bulletin No. 445 describes new model C-2 Megohmer, an insulation tester. Illustrations and performance data are given. Herman H. Sticht Company, Inc.

STEEL FRAME WORK

31 Bulletin No. 1 illustrates and describes the Attwood system of frame construction using "Unistrut". With it, any type of frame for supporting or holding pipes, conduits, etc. and for storing bars, wheels and other products can be built. Unistrut Corporation.

CALCULATOR

32 A new "Handy Calculator" to help solve woodworking problems. By adjusting dial you can convert linear to board feet, determine slope per foot in degrees, find comparative hardness, weights, shrinkage, warping and ease of working of various woods. Price 10 cents. Write to Greenlee Tool Co., Rockford, Ill.

Our Next National Electrical Code

[FROM PAGE 50]

In small breakers, it is said, that soon there should be available all the wartime technological developments of small air circuit breakers hitherto unavailable commercially. Compact unit designs of breakers, thermal and magnetic, would seem to provide an answer to the problem of the maintenance of correct circuit protection, especially if this form of circuit protection can be made available at reasonable prices.

The unit idea is the modern conception for merchandising, and it will be expanded in the electrical business. Modern efficiency will call for self-contained or self-restoring units, in place of spending time in the field assembly of parts, either initially or on subsequent need for replacement.

Lighting Rules

Advances in the art of lighting carry promise of excellent postwar business. Circular fluorescent tubes, the standardization of cold cathode tubes and other accessories, and the passing of the starter are indicative of coming changes in fixture design. Fortunately, Code makers will have the benefit of years of experience when they come to write regulations on these developments. There will be questions to be answered. How should cold-cathode transformers be installed? What new rules, if any, will be needed to keep the Code safeguards abreast of luminous-tube lighting systems?

The newer lighting systems have brought up questions on circuiting and fixture voltages. Lighting units have been successfully supplied directly from power feeders without intervening transformer, as with the 266-volt fluorescent fixture employing two lamps in series on the 460-volt star systems. High-voltage cold cathode transformers are available with 230- or 460-volt primaries.. The Code Supplement removed the 150-volt to ground limit from fixtures under certain installation conditions. These new practices seem to call for Code changes.

The war has brought many changes to industry. Just one example would be the spray booth as it is used today. What used to be thought of as an enclosure in which to apply lacquer to a chair has become large enough to accommodate a four-motored bomber. And, naturally, the ideas of how to illuminate such enclosures have had to be expanded.

Fortunately, all new applications for electricity do not necessitate Code changes as witness the induction heating industry which has supplied a large part of its requirements by means of self-contained, high-frequency, motor, generator sets. It is about the same story with electronics, where these vacuum tube devices have been incorporated into self-contained units, just like motor controllers. In the power conversion applications the picture may be different, but here again there has been so much of this sort of equipment put into use since the writing of the last Code, that the Electrical Committee will be able to know from experiences gained if Code regulation is necessary or desirable.

Networks and Infra-red

Other developments being investigated by special technical sub-committees include industrial networks and infra-red ovens. It is good that the problems of these developments are being resolved especially when units like 4,000 kw. infra-red ovens are being built.

To the members of the 1945 Electrical Committee will fall the privilege and the responsibility of laying down the wiring regulations to safely guide the industry through the days of reconstruction. The task is entrusted to capable hands.

REPAIR SPECIALIST R. L. Brooks, shop supt., Houston Armature Works, Houston, Texas, finds shortage of skilled help biggest obstacle to rushing motor repairs for Houston's shipyards and industrials. His background of 23 years with the company comes in mighty handy these days.

IN THE NEWS

FIXTURES CONTROLLED BY L-41

The installation of lighting fixtures has been defined as construction, according to an interpretation of the WPB legal division and consequently subject to the conditions of Limitation Order L-41.

The statement given to the Fluorescent Lighting Fixture Industry Advisory Committee and released to the industry said:

"(a) Installation of lighting equipment comes within the definition of 'construction' in paragraph (b) of Order L-41 and is therefore within the scope of that order.

"(b) Application for ratings to get lighting equipment to be installed in buildings or structures must be made on one of the forms listed in Schedule C of L-41 (depending on the type of construction involved) except in the following cases:

"(1) Where permission for construction is not needed under L-41, paragraphs (c), (d) and (e), persons entitled to use a blanket MRO rating of AA-2 or higher under CMP Regulation 5 or 5A or any order in the "P" or "U" series may use this blanket MRO rating only to the extent permitted by the particular order or regulation. (Priorities Regulation 3, List B, prohibits the use of blanket MRO ratings lower than AA-2 to get lighting fixtures.)

"(2) Where (i) permission for construction is not needed under L-41 and (ii) the purchaser is not entitled to use a blanket MRO rating of AA-2 or higher and (iii) only one class of equipment is needed, then application for a rating may be made on Form WPB-541 (PD-1A)".

EEI ANNUAL MEETING HELD IN NEW YORK

A more aggressive spirit in defense of free enterprise was dominant at the annual meeting of the Edison Electric Institute, which was held in New York on June 6 and 7. Indications of that purpose were apparent in the papers and addresses and in two important actions taken. The first of these was passage of resolutions aiming at consolidation of industry associations into one effective organization. The second was a change in the constitution of the Institute and the election of officers in conformance with it.

Many interesting papers were presented. G. V. Rork, Northern States Power urged upon management to consider area- and community-wide planning of rural service. He said that the question before the utilities today is not whether farm service can stand on its own feet in business terms but is one of developing it to the point of firm footing. Construction of rural extensions is no longer the engineering problem it once was; the concern now is to make electricity the "farmer's best hired man." To this end Mr. Rork advised that line extension rules be examined and conformed to local desires and conditions as revealed by survey. They should be simplified so that customers can understand them and liberalized to allow ample money to remain in the hands of farmers to pay for adequate wiring and useful equipment. And intensive effort should be given to promoting the many uses of electricity in modern farming.

The heat pump as a load builder was discussed by Philip Sporn, vice president and chief engineer, American Gas & Electric Service Corp. Reverse refrigeration holds out great promise for home and other space heating, said Mr. Sporn. It can readily be made competitive with fuels and offers a prospect of average annual domestic consumption of over 14,000 kw.-hr.

After the necessary change in the constitution had been adopted the following directive personnel was elected. C. W. Kellogg, President; J. W. Parker, Vice President, The Detroit Edison Co.; H. B. Bryans, Vice President, Philadelphia Electric Co.; H. S. Bennion, Vice President and Managing Director; Gilbert W. Chapman, Treasurer, American Water Works and Electric Co.; Mae B. Woods, Secretary.

RENEGOTIATION REGULATIONS

New renegotiation regulations have been issued by the War Contracts Price Adjustment Board.

The regulations issued comprise four chapters and, with revisions of four chapters originally issued on April 19, complete the initial basic codification of the first detailed rules to be publicly issued in connection with renegotiation of war business done by contractors in fiscal years ending after June 30, 1943. Supplements and revisions will be issued from time to time.

The new chapters are as follows:

Chapter III, dealing with determination

"I still don't see what difference it would make if we just put these up in a braid."

MANY IMPORTANT AND EXCLUSIVE WIRING

Advantages

BEGAN WITH THE USE OF PORCELAIN PROTECTED WIRING SYSTEMS

More than 50 Years Ago

- COMPLETE INSULATION
- FULL PROTECTION
- SHORT PROOF
- SHOCK PROOF
- RUST AND CORROSION RESISTANT
- PERMANENT
- ADEQUATE
- ECONOMICAL
- MAXIMUM CURRENT CAPACITY RATINGS
- TAKES STANDARD DEVICES AND FIXTURES
- MAKES INSTALLATIONS EASIER
- MEETS FUTURE LOAD INCREASES

Though Porcelain Protected Wiring is the oldest system, it is up-to-the-minute in modernity and will continue to be modern even as times advance. This has been so now for more than fifty years. Each era has proved porcelain to be adequate as the use of electric lighting and electrical appliances increased. As years followed installations the ability of porcelain to allow for easily made alterations and additions was demonstrated.

Along too with time, porcelain has proved its permanent and safeguarding qualities. Customers who know the advantages of porcelain and its economy are quick to approve its use. Contractors gain by building good will.

In keeping with the spirit of today, porcelain conserves vital materials so important in America's victory drive.

★ **ILLINOIS ELECTRIC PORCELAIN CO.** *Macomb, Ill.*

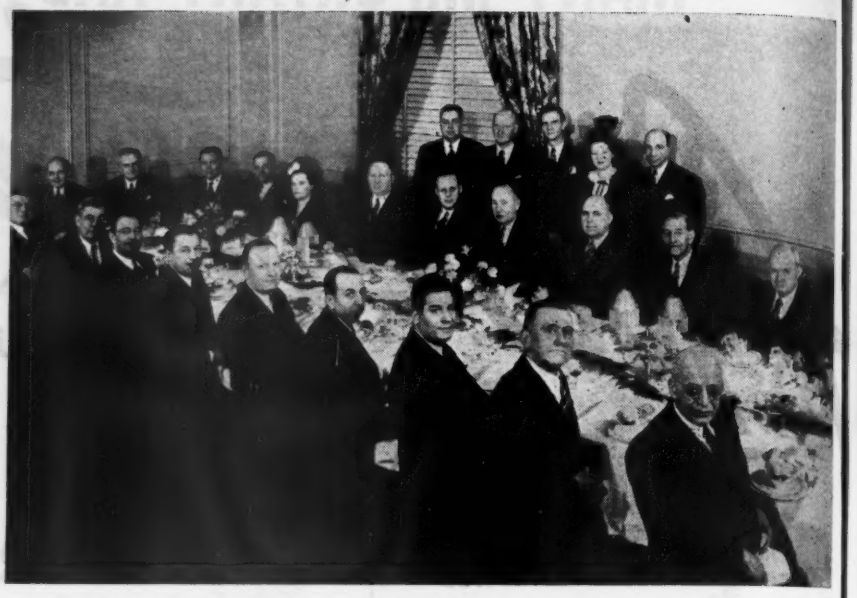
★ **PORCELAIN PRODUCTS, INCORPORATED** *Findlay, Ohio*

★ **SPECIALTY PORCELAIN WORKS** *East Liverpool, Ohio*

★ **SUPERIOR PORCELAIN COMPANY** *Parkersburg, W. Va.*

★ **UNIVERSAL CLAY PRODUCTS COMPANY** *Sandusky, Ohio*

MODERN PORCELAIN PROTECTED WIRING SYSTEMS



OLD TIMERS' DINNER given by Wm. J. Wheeler, president of The Maintenance Company of New York City to honor the 20 Mainco men and women who have completed 25 or more years of loyal service with the company. Gold pocket watches were given the two men of 40 years service, George P. Buckland and Wm. T. Gardiner. Wrist watches were presented the six 30 and 35 year men while all the others received silver trays of appropriate design.

of renegotiable business and costs, consists of eight sections. The first discusses the method of renegotiating on an over-all company basis rather than a per contract basis, and cites certain authorized exceptions to this method. Section two covers the problems of segregating sales of contractors, those that are subject to renegotiation and those that are not. Contracts and subcontracts coming within the scope of the Renegotiation Act, mandatory exemptions and exclusions and permissive exemptions from renegotiation and time limitations for renegotiating are covered in Sections three through seven, while Section eight takes up the question of costs and their allocation as between renegotiable and non-renegotiable business.

Chapter IV deals with the determination and elimination of excessive profits, with special regard to principles and factors to be taken into account in determining excessive profits. This chapter also discusses methods of recovering excessive profits already realized and of preventing, through price reductions, excessive profits likely to be realized in the future. It closes with a section on adjusting renegotiation results for taxes.

Chapter V covers the form and content of agreements between the Government and contractors, clearances where no excessive profits appear and statements to be furnished to contractors upon their request under provisions of the new act.

Chapter VI, devoted to impasse procedure, likewise takes up proceedings for the redetermination of excessive profits by the Tax Court of the United States under powers conferred on that court by the new Renegotiation Act.

Also included in this action are revisions of and additions to Chapters I, II, VII and VIII, originally released on April 19. The new chapters, as well as the revisions and additions, are published in the Federal Register and have been released in full to the law services.

It is expected that the Superintendent of Documents will publish the Regulations in loose-leaf form and will make them available to the public at a subscription price of $2, which includes 12 monthly supplements embodying revisions, which will be made by the War Contracts Board from time to time, the board said.

The agencies to which the Renegotiation Act and these Regulations apply are the War, Navy and Treasury Departments, the Maritime Commission, the War Shipping Administration, and the Reconstruction Finance Corporation for four of its subsidiaries—Defense Supplies Corporation, Defense Plant Corporation, Metals Reserve Company, and Rubber Reserve Company.

COMMITTEE WORKING ON WIRING HANDBOOK

Consideration is being given to a revision of the various sections of the Handbook of Interior Wiring Design by the Industry Committee which has been reorganized and which is representative of all branches of the electrical industry. This move is taken in view of the experience gained over the past few years and with the objective of having the standards brought up to date for application in all types of postwar building construction and modernization.

E. A. Brand of the Buffalo Niagara and Eastern Power Corporation, Buffalo, N. Y., has accepted reappointment to the chairmanship. Working with him, representing the various branches of the industry, are F. N. M. Squires and Charles A. Ward of the International Association of Electrical Inspectors; Richard Slauer and Leo Dolkart, representing the illuminating Engineering Society; D. L. Ripley, representing American Lighting Equip-

ment Association, Inc.; L. F. Adams, Frank Thornton, Jr., H. G. Knoderer, H. E. Metz, William Seubert and H. H. Weber, representing the National Electrical Manufacturers Association; Allan Coggeshall and George H. McKee, representing the National Electrical Contractors Association, and D. M. Salsbury, representing the National Electrical Wholesalers Association. A. C. Bredahl is secretary of this committee and is also chairman of a technical committee which has been appointed to consider suggestions for revision, to be passed through to the main committee for action.

It is also contemplated that representatives of the architectural, building and financing interest, and of the national consumer, shelter and building publications, will be invited to offer suggestions.

Realizing that the most immediate need is consideration of revisions to the Residential Section, the committee is giving first attention to that part.

It is also planned to include a section on minimum wiring adequacy for farmsteads.

The committee will welcome suggestions from members of the industry for items which they feel should be taken into account in revising this industry handbook. Letters should be addressed to A. C. Bredahl, c/o Westinghouse Electric & Mfg. Co., 306 Fourth Avenue, Pittsburgh 30, Pa.

OPA SETS PRICES FOR ARMORED CABLE

Dollars and cents ceiling prices for three types of armored cable which have not heretofore been covered by revised price scheduled 82 have been established by the Office of Price Administration.

The additions, with prices varying by size and shipping zones, are armored leaded cable, 150 ft. coil, $147.80 to $161.40; bare armored ground wire (solid), 250 ft. coil, $32.12 to $66.90; and bare armored ground wire (stranded), 250 ft. coil, $35.20 to $73.81.

***RURAL WIRING** problems occupy leisure time of (L. to R.) contractor Oliver N. Larson, Faribault, Minn., and REA electrical inspector T. A. Thompson, Hutchinson, Minn. at recent N.C.E.I. War Conference in St. Paul.*

REBUILT MOTOR CEILING REVISED

Ceiling prices for fractional horsepower rebuilt and guaranteed motors at retail now set the maximum at 75 percent of new motor price plus $7.00. In the statement, which accompanied the OPA order, Administrator Chester Bowles explained that it was directed toward filling the critical need for appliance motors. The 85 percent of new base price heretofore in effect practically prohibited the reuse of the cheaper fractionals since the rebuilding often cost as much or more than a new motor. The new ceilings will allow rebuilders to recover their total costs and the more efficient operators should be able to show a moderate profit.

The new order, Revised Supplementary Regulation 14 to the General Maximum price Regulation, defines a rebuilt and guaranteed motor as one in which (1) worn, defective or missing components have been replaced and repaired; (2) carries a written guarantee for a year and (3) is expressly invoiced as a rebuilt and guaranteed motor.

At retail the maximum delivered price for a ¾ horsepower or smaller motor is set at 75 percent of the equivalent new motor list price plus an additional sum of $7.00 less any trade in allowance.

At other than retail sales the price may not exceed 85 percent of the retail price. The price of second-hand motors not rebuilt and guaranteed may not exceed 75 percent of the equivalent new motor list price.

The order also sets minimums for trade-ins when used in part payment for a rebuilt and guaranteed fractional horsepower motor. The minimum allowances are: ¼ hp. or less, $1.00; over ¼ hp. and including ½ hp., $2.00; over ½ and including ¾ hp., $3.00.

Effective date of the new order was June 26. Copies of the complete text of the modification are available from the Office of Price Administration.

BRUCE SHAVERE, REA inspector of Lewistown, Montana, being congratulated by John Crawford, Butte electrical inspector and retiring chairman of the Montana Chapter, IAEI, upon his election as his successor.

EQUALLY AT HOME on the mound or in the electrical repair department is Harry Gumbert, St. Louis Cardinals pitcher and journeyman electrician. Harry was a member of the ship electrical repair crews for Maritime Electric, Inc., Houston electrical contractors working in Galveston shipyards.

PERSONNEL CHANGES ON ELECTRICAL COMMITTEE

The National Fire Protection Association has announced the following personnel changes on the Electrical Committee—

Electric Light and Power Group

A. B. Craig is no longer a member representing this group.

L. W. McCullough has been transferred from alternate to member.

Leslie D. Price, Public Service Electric & Gas Company, Newark, N. J., is alternate to O. K. Coleman.

John M. Turnbull, Service Engineer, Western Massachusetts Companies, 73 State Street, Springfield, Mass. is alternate to A. P. Good.

A. B. Campbell, formerly an alternate, no longer serves on the Electrical Committee.

American Institute of Electrical Engineers

H. S. Warren, alternate, no longer serves on the Electrical Committee.

W. R. Smith, Public Service Electric & Gas Co., Newark, N. J. has been appointed member succeeding F. V. Magelhaes.

F. V. Magelhaes has been transferred from member to alternate.

CMP REG. NO. 6 SIMPLIFIED

Simplified procedures, recently adopted for industrial construction and housing, have been expanded to include certain construction by the Army and Navy, the War Production Board has announced.

Direction No. 3 to Controlled Materials Plan Regulation No. 6, covering the new

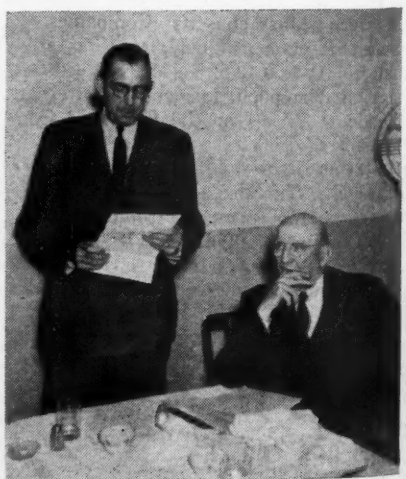
procedure provides for use of the allotment symbol W-6 by the Army and N-0 by the Navy. These symbols may be used by the services or they may grant their builders or subcontractors permission to use them in placing orders for controlled materials or Class A products with which to carry on command construction, Engineer Corps construction and CAA construction.

Branches of the Army or Navy which are carrying on command construction will be granted the right to use the appropriate symbol in purchasing controlled materials and Class A products. In turn, these branches will have the right to grant their suppliers permission to use the appropriate symbol for purchasing controlled materials or Class A products needed for the command construction.

This so-called blanket allotment procedure means that specific quantities of controlled materials will not be alloted for a particular command construction project. All materials required for the completion of the subject will be available through the use of the allotment symbol and the preference rating which will accompany the assignment of the symbol.

Both the symbol and preference rating will be assigned to the command construction project on Form CMPL-593. This CMPL form replaces WPB-542 (formerly PD-3A) for assignment of preference ratings for command construction projects and CMPL-150 for allotments of specific quantities of controlled materials for such construction projects.

Restrictions contained in the Army and Navy Munitions Board List of Prohibited Items for Construction Work will continue to apply to command construction carried on under this new procedure. Authority to deviate from these restrictions may be obtained only by the Bureau of Service carrying on the project for either the Army or Navy upon specific authorization from the ANMB. Such exceptions will be indicated on Form CMPL-593, or other appropriate form.



H. L. SCOTT, Electrical Engineering and Construction Co., Corpus Christi, Texas, tells members of the South Texas Chapter, NECA, that contractors contemplating maintenance work must have an engineering background, understand customer's production processes and expect a high tool and equipment investment and a lower volume of work.

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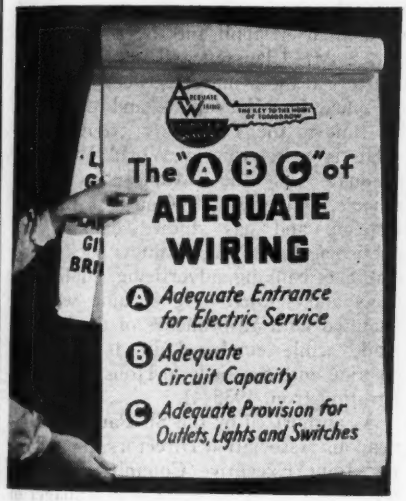
NAWB EXPANDS CONSUMER EDUCATION PROGRAM

An expanded program of consumer education on the practical aspects of electrical operation in the postwar home, has been announced by Herbert Metz, Chairman of the Executive Committee of the National Adequate Wiring Bureau. The program is to parallel the Bureau's recently announced activity, directed to the building industry.

"A rising tide of public interest in postwar home planning has created an urgent need for simple, down-to-earth educational material which will meet the requirements of electrical industry personnel, now being called upon to answer consumers' questions", said Mr. Metz. "The rapid growth of Home Planners' Institutes, sponsored by home financing agencies and trade associations within the home construction industry, is putting a demand upon the educational facilities of electrical utilities, electrical leagues and the like, and the Bureau's new educational program is designed to help the electrical industry meet this demand." Mr. Metz stated further that National Adequate Wiring Bureau Headquarters is prepared to give all possible assistance to electrical industry groups in setting up educational activities, built around successful programs now under way. Several of these are described in the current issue of the Adequate Wiring Reporter.



LECTURE CHART—This is one of the lecture charts prepared by NAWB in their consumer education program.

A new set of lecture charts, for use from the platform, and a 16-page booklet, both entitled "Electrical Guide to Your Post-War Home" form the nucleus of the Bureau's suggested program. The charts and the booklet introduce electric service as the element upon which a house must depend if it is to function as a home. They show that any home, in any size or price bracket, depends either wholly or partially on electricity for eight necessary functions. These are: illumination; cleaning and sanitation; meal preparation and food storage; heating, ventilating and air conditioning; entertaining and hospitality; education, recreation and hobbies; health protection and personal care; utility, safety and protection. The charts

and the booklet point out that even the smallest wired home uses at least one piece of electric equipment in each of these classifications.

The ABC's of Adequate Wiring are presented in relation to the benefits to be derived from a well planned electrical system.

Complete information regarding consumer programs now under way can be obtained from the National Adequate Wiring Bureau, 155 East 44th Street, New York 17, N. Y.

TWIN CITY CONTRACTORS HIRE DISTRICT MANAGER

To serve the growing needs of their membership, the Minneapolis and St. Paul Electrical Contractors Associations, which are affiliated with the Minnesota Electrical Council, have recently employed L. A. Claussen of St. Louis Park as their District Manager. Chosen from a group of more than 30 applicants by a joint committee, Mr. Claussen will make his headquarters at the Minnesota Electrical Council office in Minneapolis and devote all his time to the Twin City groups.

He is a veteran of World War I, a graduate of the Minneapolis public schools, University of Minnesota Business College, and has studied banking and public speaking. His business background embraces banking, advertising, public relations and selling. He became well acquainted with all branches of the building trade while employed in a responsible position with the Federal Housing Administration from 1935–41.

As authorized by the St. Paul and Minneapolis Association Directors, the following Joint Executive Committee together with Wm. A. Ritt, Secretary-Manager of the Council, will direct the Twin City activities: Minneapolis—John Kvalsten, Kvalsten Electric Co.; A. W. Strohmeier, Pierson Wilcox Electric Co.; C. S. Williams, Superior Electric Co.; St. Paul —Wm. F. Lindberg, Peoples Electric Co.; Arthur W. Swanson; and L. A. Rylander, Arlington Electric Company.

The joint activities program will be developed with the assistance of the Trade Relations and other standing committees of the Twin City group and will include many postwar objectives outlined in the recent Council Postwar Planning Report.

DIRECTIVE NO. 1 TO CMP REG. NO. 6 AMENDED

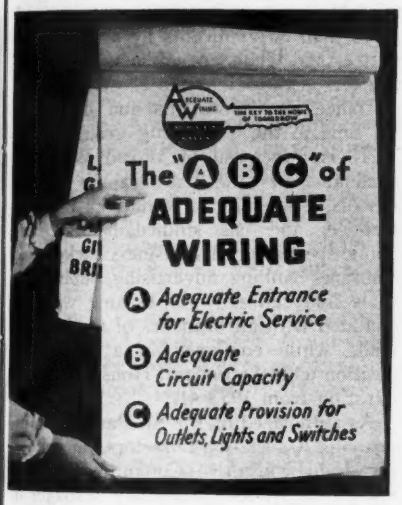
The War Production Board has announced that a list of construction materials which may not be used in industrial construction, carried on under the provisions of Direction No. 1 to Controlled Materials Plan Regulation No. 6, has been issued in Schedule A (Construction Limitations) to that regulation.

At the same time that this list of materials was published, certain changes

NAWB EXPANDS CONSUMER EDUCATION PROGRAM

An expanded program of consumer education on the practical aspects of electrical operation in the postwar home, has been announced by Herbert Metz, Chairman of the Executive Committee of the National Adequate Wiring Bureau. The program is to parallel the Bureau's recently announced activity, directed to the building industry.

"A rising tide of public interest in postwar home planning has created an urgent need for simple, down-to-earth educational material which will meet the requirements of electrical industry personnel, now being called upon to answer consumers' questions", said Mr. Metz. "The rapid growth of Home Planners' Institutes, sponsored by home financing agencies and trade associations within the home construction industry, is putting a demand upon the educational facilities of electrical utilities, electrical leagues and the like, and the Bureau's new educational program is designed to help the electrical industry meet this demand." Mr. Metz stated further that National Adequate Wiring Bureau Headquarters is prepared to give all possible assistance to electrical industry groups in setting up educational activities, built around successful programs now under way. Several of these are described in the current issue of the Adequate Wiring Reporter.



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At the same time that this list of materials was published, certain changes

were made in Direction No. 1 to CMP Regulation No. 6, to make the prohibitions on use of the specified materials and products effective.

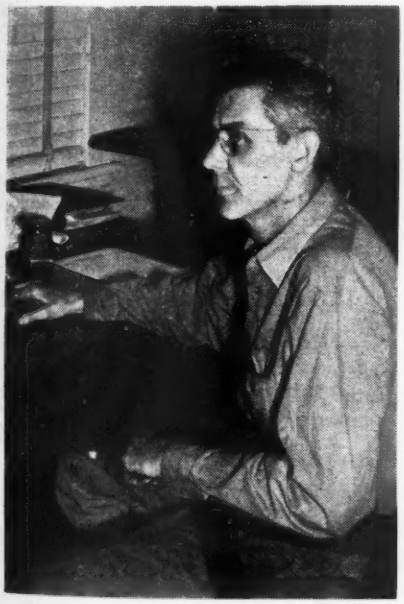
Authority to deviate from the restrictions which are contained in the new schedule may be obtained by a person carrying on a construction project at the time he files his construction and facilities application such as Form WPB-617, or such other construction authorization forms as may be provided.

Authorization to carry on industrial construction is granted to applicants on Form GA-1456. In the event WPB grants permission to deviate from the list of restricted materials, contained in Schedule A, a specific notation of such exception will be made on the authorization form itself.

Persons operating under Direction 1 to CMP Reg. 6 are urged to study these construction limitations carefully before applying for authorization to acquire or construct facilities covered by this procedure, WPB said.

The general principles originally established by Direction No. 1 (February 5, 1944) to CMP Regulation No. 6, explaining the industrial construction authorization procedure, remain effective.

However, the amended direction explains that special requests for permission to use restricted items may be made on Form WPB-617 applications. If the restricted items are listed in Appendix I of Schedule A or are listed on Appendix II of the Schedule A and no separate application form is prescribed, application for permission to use them should be made on Form WPB-617. If the items appear in Appendix II of Schedule A and a special application form is prescribed, this form should accompany WPB-617 when filed.



ALMOST 20 YEARS service with Central Electric Co., Fort Worth, Texas motor service shop, is the proud record of shop supt. James M. Morgan. Since 1923, except for 16 months in electrical maintenance at the Consolidated Aircraft Corp. Fort Worth plant, Jim has been a familiar and valuable figure in Central's shop.

RICHMOND LEAGUE OFFICERS

At the May meeting of the Electrical League of Richmond, Va., the following officers were elected for the year 1944-45—president, L. L. Bond; vice president, A. B. Schad; treasurer, B. H. Cousins and secretary, W. E. Epperson.

PRIORITIES REGULATION NO. 13 REVISED

The June revision of Priorities Regulation No. 13, governing special sales of materials and products from idle and excess stocks, was announced by the War Production Board.

Changes in the regulation are of a technical and perfecting nature. Rules governing special sales of certain chemicals and miscellaneous products have been revised as to details.

Special sales of materials and products are those made by persons who are not regularly engaged in the business of selling the material in the form in which it is held.

Regular monthly revisions of Priorities Regulation No. 13 are made to conform rules governing sales of specific items of materials and products to actual supply conditions, which change from time to time.

LYNETT ELECTED PRESIDENT OF IAEI

James D. Lynett, supervising chief inspector, Department of Electricity, New York City, and first vice president of the IAEI, has been elected president of the International Association of Electrical Inspectors. The other officers are L. P. Dendel, first vice president; B. C. Hill, second vice president; W. R. Volheye, third vice president; Frank G. Camus, fourth vice president and Victor H. Tousley, secretary-treasurer.

Mr. Lynett is a member of the Electrical Committee, NFPA, representing the United States Conference of Mayors, a member of the Electrical Council of Underwriters' Laboratories, and a member of the American Institute of Electrical Engineers.

ZINC ORDER AMENDED

Minor amendment of the conservation order governing use of zinc was announced by the War Production Board. With two exceptions, the changes in M-11-b provide for no additional consumption of zinc, but merely incorporate the permission to use the metal in the manufacture of certain articles which has

recently been granted on appeal. Included in the group that no longer need make individual appeals are those using zinc for research, developmental and experimental activities.

Restored uses of zinc, expected to result in an additional annual consumption of not more than 500 tons, are in the manufacture of laundry tags and protective edging and corner beading for construction work. In both cases, superior products and savings in man-hours and substitute materials will result, WPB officials said.

WESTERN PENNSYLVANIA LEAGUE OFFICERS

At the March meeting of the Board of Directors of the Electric League of Western Pennsylvania, Pittsburgh, Pa., I. W. Danforth and Harry Restofski were elected president and vice president respectively to succeed J. R. Richards and George S. Hards. Ludwig Hommel continues as treasurer and F. A. Kolb as secretary.

SPACE CONTROL COMMITTEE FORMED

William L. Clayton, Surplus War Property Administrator, has announced the formation of a Space Control Committee to coordinate the surplus war property storage activities of Government agencies.

The Federal departments and agencies represented on the committee are the War Department, Navy Department, Maritime Commission, Procurement Division of the Treasury Department, and the Reconstruction Finance Corporation.

The Space Control Committee through the cooperation of the agencies represented will establish a record of space available and will lend mutual assistance in locating space required for the storage of surplus property.

The chairman of the Space Control Committee is Col. John J. O'Brien, Office of the Chief of Engineers, War Department, Washington.

DIRECTIVE NO. 24 AMENDED

Directive No. 24, which delegates authority to the National Housing Agency for housing construction, has been amended to permit NHA to issue approvals in the name of the War Production Board on the form required by any L, M, or P order for the purchase of building products and materials for such housing projects as now come under the jurisdiction of NHA, according to WPB.

The authority granted may be exercised only to the extent that approved WPB program determinations or approved decisions of a WPB industry division speci-

fically grant permission to issue approvals by NHA within specified quotas of such products or materials. Approvals may be issued only for products or materials whose permitted use is authorized by the War Housing Critical List and the War Housing Standards under Limited Preference Order P-55-c.

INTERNATIONAL LIGHTING EXPOSITION SET FOR APRIL, 1945

The Industrial and Commercial Lighting Equipment Section of the National Electrical Manufacturers Association, has announced that it is sponsoring the International Lighting Exposition which will be held at the Palmer House in Chicago from April 19 until Monday, April 23, 1945, inclusive. The exposition will be open every day including Saturday and Sunday.

The exhibits will be restricted to NEMA members, making various types of lighting and accessory equipment and to certain non-member groups of lighting sources and non-electrical accessories. Invitations to attend the exposition will be sent to the electrical wholesalers, electrical contractors, the sales and illuminating engineering departments of electric light and power companies, architects and consulting engineers, maintenance and plant engineers of industrial plants and other similar selected groups.

DATES AHEAD

George Washington Chapter IAEI — Monthly meeting, District Building, Washington, D. C., July 10.

Rocky Mountain Chapter IAEI—Monthly meeting, Denver, Colo., July 11.

Roger William Chapter IAEI—Monthly meeting, Providence, R. I., July 19.

Louisiana and Mississippi Chapters, Southern Section, IAEI—Joint Meeting, Walthale Hotel, Jackson, Miss., July 28-29.

Utah Chapter IAEI—Monthly meeting, Salt Lake City, Utah, August 1.

International Association of Electrical Inspectors — Northwestern Section, Olympian Hotel, Olympia, Wash., August 21-23; Southwestern Section, Hotel Palomar, Santa Cruz, Calif., August 28-30; Western Section, Claypool Hotel, Indianapolis, Ind., September 11-13; Eastern Section, DeWitt Clinton Hotel, Albany, N. Y., September 18-20; Southern Section, Ausley Hotel, Atlanta, Ga., September 25-27.

American Institute of Electrical Engineers—Pacific Coast Technical Meeting, Biltmore Hotel, Los Angeles, Calif., August 29-September 1.

Illuminating Engineering Society—Annual conference, Edgewater Beach Hotel, Chicago, Ill., September 14-16.

American Standards Association—Standards Council, New York, N. Y., September 21.

National Electrical Contractors Association—Annual meeting, French Lick Springs Hotel, French Lick, Indiana, Oct. 1-5.

International Municipal Signal Assn.—Annual meeting, Hotel Statler, Boston, Mass., Oct. 2-4.

National Electronic Conference—Medina Club, Chicago, Ill., Oct. 5-7.

Electronic Parts and Equipment—Industry Conference, Edgewater Beach Hotel, Chicago, Ill., Oct. 6-9.

National Safety Congress of National Safety Council—Sherman, Morrison and

La Salle Hotels, Chicago, Ill., October 3-5.

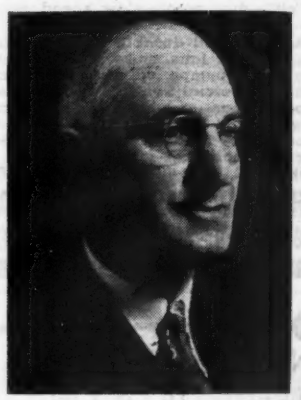
National Electrical Manufacturers Association—Annual meeting, Waldorf-Astoria Hotel, New York, N. Y., October 23-27.

International Lighting Exposition — Palmer House, Chicago, Ill., April 19-23, 1945.

MANUFACTURERS NEWS

WESTON ELECTRICAL OFFICERS

Weston Electrical Instrument Corp. of Newark, N. J., has elected Edward F. Weston chairman of the board of directors. In assuming the chairmanship of the board, Mr. Weston fills an office vacant since the death, in 1936, of his father, Dr. Edward Weston, founder of the company which bears his name. Mr. Weston



CAXTON BROWN

H. L. GERSTENBERGER

has been with the company since his graduation, as an electrical engineer, from Columbia University, in 1900.

Caxton Brown, the new president, has been executive vice president and secretary since 1939. He will assume responsibility for policy decisions on the company's many administrative and organizational problems. Mr. Brown has been with Weston 43 years. He was made vice president and secretary in 1925 and executive vice president and secretary in 1939.

H. Leigh Gerstenberger, general sales manager since 1932, has been made vice

president in charge of sales, succeeding Caxton Brown. Mr. Gerstenberger has been with Weston since 1917, shortly after his graduation from Stevens Institute of Technology. He served in both export and sales departments prior to his appointment as general sales manager.

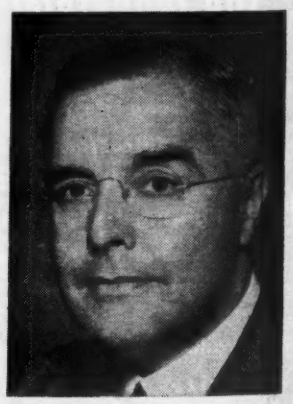
Earl R. Mellen was elected executive vice president and treasurer. He joined the company in 1917, and has successively served as credit manager, assistant treasurer and treasurer.

Other officers elected include: R. R. Lambe, vice president in charge of manufacturing; W. Nelson Goodwin, Jr., vice president in charge of engineering; Ross Nichols, secretary and Thomas L. Evans, comptroller and assistant secretary.

WESTINGHOUSE CHANGES

John M. McKibbin has been appointed assistant to vice president of the Westinghouse Electric and Manufacturing Company. Formerly manager of the Company's Application Data & Training Department. Mr. McKibbin's new responsibility will include all product and industry advertising, in addition to his present duties.

J. M. McKIBBIN



J. B. MacNEILL

J. B. MacNeill has been named manager of the Switchgear and Control Division. He succeeds R. A. Neal, whose election as a vice president and assignment to new duty was recently announced.

R. C. Brannan has been appointed manager of the Transformer Equipments Section of the Transformer Division at Sharon, Pa. He was formerly headquar-

ters commercial engineer in the Power Transformer Section.

R. A. McCarty, vice president of Westinghouse in charge of its subcontracting activities, has been granted a leave of absence to assume an executive position in Washington with the Smaller War Plants Corporation. The Westinghouse Headquarters Subcontracting Department has been brought under the direction of Andrew H. Phelps, vice president, who is in charge of purchases and traffic for the company.

Dan M. Galvin has been named district manager of the Lamp Division's Southwestern District with headquarters in St. Louis, Mo. Mr. Galvin has been serving as acting manager at St. Louis since 1942.

Theodore C. Monk, who joined the Westinghouse Lamp Division in 1920, has been appointed assistant to manager.

Ross Rathbun, manager of air conditioning at the Westinghouse Electric Elevator Company in Jersey City, N. J., has announced the appointment of three men to executive positions on his staff. L. Gale Huggins was named assistant manager of air conditioning and will be general assistant to Mr. Rathbun in administration, engineering and application matters; Walter C. Goodwin becomes negotiation manager with responsibility for application engineering and negotiations, and Howard A. Blair was appointed service manager.

NATIONAL CARBON ELECTIONS

Arthur V. Wilker has been elected president of National Carbon Company, Inc. and Canadian National Carbon Company, Ltd., Units of Union Carbide and Carbon Corporation.

J. M. Spangler has been made vice president and general manager of the National Carbon Co. Mr. Spangler joined the company in 1915. He has served as

J. M. SPANGLER

manager of the railroad department, head of the western sales division, with headquarters in Chicago, manager of the eastern division, with offices in New York, and general sales manager. In 1940 he was elected a vice president.

W. B. Pritz has been made vice president in charge of manufacturing. He was formerly general works manager in Cleveland.

GRAYBAR CHANGES

Last month Walter P. Hoagland, vice president and central district manager of the Graybar Electric Company retired from the company after 44 years of service.

He was succeeded by George J. Cossmann, formerly assistant central district manager, who takes over his predecessor's

W. P. HOAGLAND

G. J. COSSMANN

duties as central district manager which includes supervision of the Chicago Main House and Branch Houses in Indianapolis, Grand Rapids, Milwaukee, Davenport, Hammond, Peoria and Des Moines.

W. E. Guy was named district commercial manager at Chicago, succeeding J. H. Gleason, who, pending his retirement in a short time will remain in an advisory capacity.

CANNON APPOINTS ENGINEERING REPRESENTATIVES

The Cannon Electric Development Company of Los Angeles, Calif., announces the appointment of five new engineering representatives.

James L. Wright, Jr., has opened his office as Wright Engineering at 6109 North Meridian St., Indianapolis 5, Ind.; Franklin Sales Company, Central Savings Bank, Denver 2, Colo.; Bruner Corporation, 418 W. North Ave., Milwaukee 12, Wis.; Southern Sellers, 918 Union St., New Orleans, 13, La.; and Mountain States Engineering Co., 215 W. Second, Salt Lake City 1, Utah.

General Electric Company, Bridgeport, has announced the appointment of Paul A. Tilley as manager of the appliance distributing branches. Mr. Tilley is responsible for all operations of these branches, which are located in Boston, Newark, New York, Philadelphia,

P. A. TILLEY

Tampa, Cincinnati, St. Louis and Los Angeles. His headquarters will be in Bridgeport.

Mr. Tilley will continue for the present in his position as manager of sales in the Ship Fittings Division of the company, which position he has held since September, 1942.

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Porcelain Products, Inc., Findlay, Ohio has named Raymond Ackerman of Salt Lake City as sales representative for the territory which includes Utah and parts of Nevada and Wyoming.

•

General Controls Co., Glendale, Calif., recently opened new branch offices at 687 Boylston Street, Boston 6, Mass., and at 1505 Broadway, Cleveland, Ohio. The Boston Branch is under the direction of Branch Manager William Marsh and L. E. Wetzel is the branch manager at Cleveland.

•

Littelfuse Incorporated of Chicago, Ill., and El Monte, Calif., has announced the appointment of Garet W. Denise, as general manager of Chicago Plant Operations. Mr. Denise was formerly with the Republic Aviation Corporation of Farmingdale, L. I.

•

Westinghouse Electric Supply Company has announced the appointment of H. I. McConnell as central district manager with headquarters in Detroit. Since 1940, he has been manager of the Virginia Division, with headquarters at Richmond.

•

The Laduby Company, manufacturers of electrical specialties, have moved into a new factory at 176-182 Oak Street, New Haven, Conn.

WHERE TO BUY
Equipment, Materials and Supplies for Electrical Construction — Maintenance — Repairs

When you're in need of some product or service to speed and improve operation, or save money, you may find it here — in the Where To Buy Section. It pays to check this page . . . *each issue.*

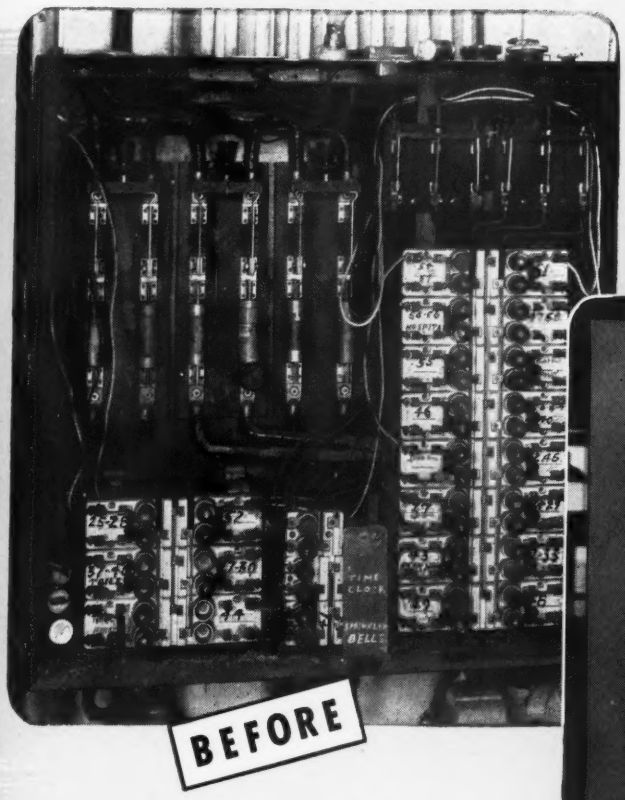
SEARCHLIGHT SECTION

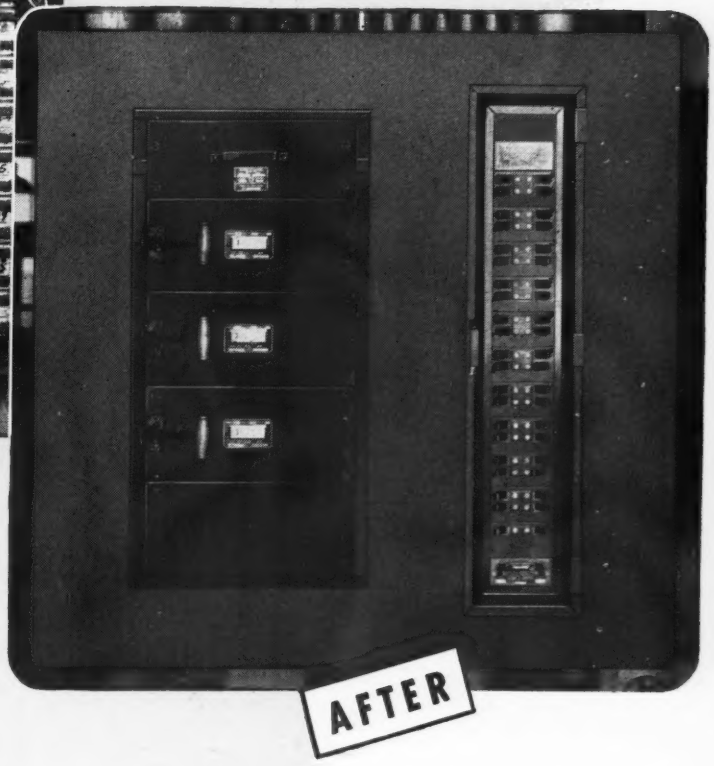
Alphabetical Index to Advertisers

July, 1944

★ **These companies have included Briefalogs, containing additional buying information on their products, in the 1944 edition of the Electrical Buyers' Reference.**

No Plant Too Large *or too small* To Profit by this SQUARE D *Conversion Plan!*





Contractors, here are facts you can use in developing a lot of worthwhile industrial business. Panelboards, taxed beyond their efficient capacities, are a drain on the productivity of any plant—regardless of size. This speedy Conversion Plan involves such a moderate investment that it "pays off" in a hurry, even in the smallest plant.

The pictures above show a typical conversion. With a minimum of time and labor and at no increase in space, 25 lighting circuits were increased to 42—up 68%. Circuit breaker convenience and protection replaced obsoleted fusible circuits. Notice, too, that Saflex units were installed for the main controls, with sufficient space provided for an additional circuit, if and when it is needed.

Remember, such conversions as these utilize **existing boxes** and conduit. The cost in time and **money is small.** The dividends in conserved power and increased efficiency is substantial. Get this story over to your industrial customers and prospects and you'll get results.

***Write for* a free copy of "MORE CAPACITY" which shows a variety of conversions in detail. Address Square D Company, 6060 Rivard Street, Detroit 11, Michigan.**

SQUARE D COMPANY

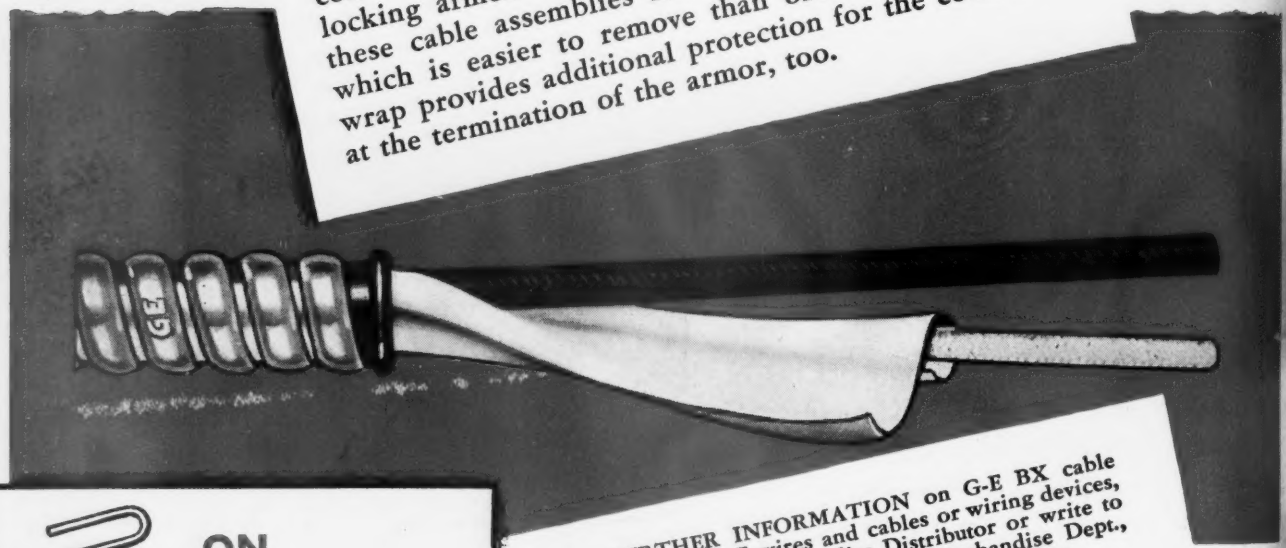
DETROIT • MILWAUKEE • LOS ANGELES

GENERAL ELECTRIC BX FLEXIBLE ARMORED CABLE ASSEMBLY

For Economical, Easy-to-install Wiring Systems

The General Electric "BX"—Armored Cable Assembly—provides self-protected wire ways. No additional protection is required. They are ideal for use in homes, markets, shops and small buildings of all types. They can be used for wiring leads to factory machines and for extension wiring from conduit for any purpose.

General Electric BX Cable Assemblies are available with two and three conductors sizes 14 to 2 or with four conductors sizes 14 to 4. The flexibility of their interlocking armor makes them easy to handle. Moreover, these cable assemblies have an S-shaped paper wrap, which is easier to remove than ordinary wraps. This wrap provides additional protection for the conductors at the termination of the armor, too.



ON ADEQUATE WIRING

A. E. Schanuel of the National Adequate Wiring Bureau said at the NEWA meeting in Chicago, "While adequate wiring adds up to a mere trifle at the maximum, it is the very heart of a major part of post war home building."

ADEQUATE WIRING SERVES AND SAVES — THE KEY TO THE HOME OF TOMORROW

FOR FURTHER INFORMATION on G-E BX cable assemblies or on G-E wires and cables or wiring devices, see the nearest G-E Merchandise Distributor or write to Section CDW742-8, Appliance and Merchandise Dept., General Electric Company, Bridgeport, Connecticut.

G-E BUILDING WIRES AND WIRING DEVICES

You'll find the wires and cables and wiring devices in the G-E line to meet your needs. There are various building wires including Types SN and SNW Flamenol small diameter thermo-plastic insulated wire and hundreds of switches, outlets, lampholders, connectors, fuses, etc.

Hear the General Electric radio programs "The G-E All Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news every weekday 6:45 P.M. EWT, CBS.

★★★ BUY WAR BONDS AND KEEP THEM ★★★

GENERAL ELECTRIC